

Paulo Sampaio · Pedro Saraiva *Editors*

Quality in the 21st Century

Perspectives from ASQ Feigenbaum
Medal Winners

 Springer

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Medal Winners

With the contribution of the following ASQ Feigenbaum Medalists: Pedro Saraiva 1998, Rajesh Jugulum 2001, Denis Leonard 2004, Barbara Santiano 2005, Elizabeth Cudney 2007, Kandy Senthilmaran 2009, Jamison Kovach 2010, Paulo Sampaio 2012, Austin Lin 2013

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*To Armand Val Feigenbaum
and all Quality Believers.*

Foreword 1

This work, “Quality in the 21st Century: Perspectives from ASQ Feigenbaum Medalists” is a collection of perspectives from individuals who at an early stage in their careers have distinguished themselves in the field of quality and who hold much promise for the future of quality. Through their shared insights and perspectives, they offer their views of the future.

When we combine the insights of these young professionals with the insights of leaders from various fields and stages of their careers, as those recently published in 2015 ASQ’s Future of Quality Report, we see that the possibilities are endless and the challenges of the twenty-first century are many. There is a shared vision and understanding among them that the pace of change is accelerating, that as complexity increases quality is essential, and exploring and exploiting connectedness will enable great achievements through quality.

At this “intersection of past and present” as one of our authors, Austin Lin, put it, we often learn that what was once considered fact becomes less certain, that what was once cutting-edge technology is quickly obsoleted, so new thinking and approaches are needed to achieve future solutions to questions and issues. Those with a quality mindset humbly understand that the world is constantly changing around us and that we must be ready to adapt our thinking and approaches. Experts who believe that they have more to teach than they have to learn will fall behind.

If we look back at the earlier days of the quality movement, we see progress has been made; many people have benefitted from the real impact of quality in their lives—in education, healthcare, transportation, water and food safety, and so on. But there is so much more to do. Today, as we look toward the future, we see emergence of new fields and convergence of existing ones: of technologies, areas of study and disciplines (for example, genetics, biology, physics, biophysics, electronics, software, microfluidics, human development and learning). There are interdependencies that were previously never imagined. These trends will bring new surprises and challenges.

So how will quality fit into this brave new world? Quality can be the philosophical thread that connects us, and the many facets of our lives. Quality can be

the start of, not just a part of, the vision. Quality can be embedded in the strategic plan to achieve that vision, and in the micro- and macro-processes used in deployment. Quality can be there throughout: at the beginning, across interfaces, in the data and inputs, and in decision-making, to better assure we achieve expected outcomes. Our authors' perspectives give us the collective courage to move forward and make this future a reality. They challenge us, not to abandon past frameworks, tools, and lessons, but to adapt them in new ways, while we strive for needed innovations in quality.

Current quality professionals, and those interested in becoming quality professionals in the future, will benefit from the insights of these award winning quality colleagues. These readings should provoke questions about the future role of quality professionals as leaders in the quality movement, and the role of quality in the future: from a philosophical dialogue about quality as a way of life and a way of thinking, and from critical and practical discussions about evolving the tools and practices of quality.

It is my hope that this work will also be shared with a much broader audience of professionals and leaders seeking improvement and performance excellence. Through this kind of sharing of perspectives and learning, this collaboration across the interfaces of needs and knowledge, quality can be fully integrated in the future. Our challenges as quality professionals are exciting. To achieve a future of fully integrated quality, we must

- Apply and adapt our current knowledge and experience to address a broader range of issues.
- Engage others and collaborate.
- Explore innovative solutions to provide future breakthroughs and prevent unexpected breakdowns.
- Advance and align quality philosophy and principles within human learning experiences and emerging technologies.
- Be servant leaders at every level, serving societal (customer) needs.
- Be brave, be bold, and enjoy the journey.

Feigenbaum is quoted in the book as saying—

Change and innovation are as much attributes of quality and how we manage quality as they are of the products, processes, and services that are produced and delivered.

I would go further to add that in the future—

Quality is integral to our values, to how we lead, how we manage people and processes, so that the products and services we deliver fulfill the promises we make.

Cecilia Kimberlin Ph.D., CQM, CQA,
RAC 2015 Chair, ASQ Board of Directors

Foreword 2

The Contributions to Quality Development of Young Practitioners

An Introduction to the ASQ Feigenbaum Medal

The Armand V. Feigenbaum Medal was created by the American Society for Quality in 1997 to honor the early career contributions of Dr. Feigenbaum and to encourage the early career development of others in this field. The Medal is presented to an individual who is 35 years of age or younger (as of the first of October in the year of application), who has displayed outstanding characteristics of leadership, professionalism, and potential in the field of quality; and whose work has been, or is anticipated to become, of distinct benefit to mankind. Dr. Feigenbaum (1922–2014) began his career in quality during the Second World War and published his doctoral dissertation on the subject of quality which became his first book in 1945 (*Quality control: principles, practice and administration; an industrial management tool for improving product quality and design and for reducing operating costs and losses*). By 1956 his ideas had consolidated into a *Harvard Business Review* article “Total Quality Control” which described a holistic approach to the management of quality, rather than one that was purely technically oriented or inspection based. Thus, in his first 35 years he had laid the foundation for his life’s work in the development of the concepts for an approach to management that evolved into Total Quality Management (TQM).

Reflections on My Own Early Career and Its Progression

In life new theory does not emerge fully mature from the womb of the mind. It arrives as a nascent idea or concept that is in need of development and maturing. This is especially true of abstractions, like quality, where there is much theoretical divergence and lack of agreement on basic issues and even core definitions. For me quality is the pursuit of goodness and the avoidance of badness. This simplification allows the term to be used in a variety of ways to generate action for change from

the status quo. However, quality is used in many grammatical forms both as an object and as a modifier which complicates matters somewhat.

Reflecting upon the development and maturing of my own thinking about quality I have come to realize that I was blessed to have come into this field in a time when convergence among thought leaders had not occurred and there was wide variety in the meanings and approaches promoted to obtain quality outcomes. In the early 1980s Deming had challenged American business leaders to achieve the same degree of improvement as their competitors in Japan were achieving in his NBC White Paper: “If Japan Can Why Can’t We?” An early reaction to Deming’s video was the breakout of the Association of Quality and Participation (AQP) from the American Society for Quality Control [ASQC—now called the American Society for Quality (ASQ)]. AQP pursued an approach to quality that was based very firmly upon the employee involvement movement of the late 1970s and the Japanese Quality Circles which had been promoted by Kaoru Ishikawa. However, the worker-based quality systems of AQP and the technical management approach of ASQ would rejoin about 20 years later as the futility of totally independent approaches became recognized.

During this early modern quality epoch of the last two decades in the twentieth century there emerged several simultaneous trends to effect the quality improvement of organizations:

- The Profit Impact of Market Strategy (PIMS) study sponsored by General Electric and conducted by the Wharton Graduate School of Business which demonstrated that the relationship between customer-perceived quality, market share, and return on investment was highly correlated.
- Study of the Japanese approach to manufacturing evolved into a Just-in-Time movement that was stimulated by the early adoption of the methods by Hewlett-Packard and their transference into American industry which ultimately evolved into the current lean enterprise movement.
- The British Standard BS5750 became adapted for global use as ISO9000:1987 and provided the foundation for a global operational definition of a foundation of quality management practice.
- The Malcolm Baldrige National Quality Award was introduced with its operational definition of quality practices from a managerial viewpoint which encouraged executives to inquire about the practices that they employed to effect continual improvement.
- Motorola Corporation introduced the concept of Six Sigma and organized the Six Sigma Research Institute as a collaborative within the semiconductor and computer industry to more fully develop the analytical engine that drove the Japanese methods applied in TQM and convert it into a model that was more reflective of Western culture.
- Florida Power & Light directly applied the Japanese approach by successfully challenging the Deming Prize of the Union of Japanese Scientists and Engineers (JUSE).

All of these events were active in 1987 when I served as the Program Manager for Quality Leadership Development at Hewlett-Packard. Synthesizing all of this knowledge and experience into an inclusive, comprehensive approach to quality would take years as convergence of these thinking patterns was first considered mutually exclusive and not compatible. However, by the middle of the first decade in the twenty-first century convergence was becoming more acceptable.

The point in this prelude is that no quality theories or methods emerge fully mature and ready for use. They become refined over time through the crucible of practice. Seeds of wisdom are sown early but must be nurtured over time to bear fruit. This is particularly relevant for the introduction to this book as the Feigenbaum Medalists are developing new ideas that will further refine our understanding of quality and contribute to an enhanced capability for improvement of our work and lives as a result.

Comments on the Collection of Papers

This book, *Quality in the 21st Century: Perspectives from ASQ Feigenbaum Medalists*, provides a unique insight into the thoughts and minds of budding quality professionals who have demonstrated excellence in their early careers as recognized by receipt of the Feigenbaum Medal. The authors of this book are both Feigenbaum Medalists and Dr. Pedro Saraiva was the first recipient of this award in 1998. This book provides much food for thought and reflecting upon the essays by individuals who have been singled out as potential contributors and definers of the continuing evolution of quality thinking is worthwhile act of mental stimulation. Consider the ideas from these minds as works in progress ... not yet fully formed but on their way toward mainstream influence. Just as TQM did not emerge fully formed from the doctoral research of Dr. Feigenbaum but required a mental migration of almost two decades to emerge, these ideas presented in this volume are also on their way toward emergence. Enjoy the process of thinking along with these authors about what Joseph M. Juran called “the coming century of quality.”

Gregory H. Watson
Past Chairman and Honorary Member
International Academy for Quality
Past Chairman and Fellow
American Society for Quality

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Introduction

To write or edit a book is an honorable but painful and somewhat never-ending task for any University Professor. By doing so, we are sharing our knowledge and thoughts with others, expecting them to be read and useful to other people. This is even more so when we talk about books in the field of quality, given the power of this discipline in order to change for better products, processes, people, organizations, communities, or society in general.

The original idea, by one of us, for having such a book dates back to 10 years ago, but it did not move forward until we decided later on to recover it back in September 2012, when we have been challenged by Springer to write a book in the quality field. We thought about it and found appropriate to revisit and update the initial idea and thus come up with the present book concept, presented to Springer by the beginning of 2013 and promptly accepted.

This book is not aimed at providing new quality-complete formal or very well-formatted definitions, tools, or approaches, but rather tries to reflect about the past and the present of quality and, from there, extract pathways for a smiling and promising future in the field and of the field.

When doing such state-of-the-art or prospective views of any knowledge domain, one tends to rely on the writings of quite senior people and experts, usually above 60 years of age. Here, we try to do exactly the opposite, by bringing in fresh views from authors that have achieved recognition in the area of quality, but are in the mid of their careers (e.g., between 30 and 50 years of age). This was done on purpose and is a key differentiation feature of our book, since we did believe from the beginning that such views might be really enlightening, less conventional, and possibly more disruptive than usual. As the collected contributions ended up showing, with a number of well thought, sometimes more traditional but other times clearly disruptive or provocative views over the past, present but mainly the future of quality, as seen from a wide variety of perspectives and authors.

In order to identify such young but mature and recognized authors in the field of quality, we have based ourselves in the American Society for Quality (ASQ) Feigenbaum Awardees. Indeed, ASQ did set up and operates a set of awards that do recognize leadership, technical achievement, and distinguished service to

the profession, which includes the Feigenbaum Medal. Such ASQ awards recognize individuals for superior achievements in the development, promotion, and communication of quality. They are named after people who have made outstanding achievements in the field, and are presented each year at ASQ's World Conference on Quality and Improvement.

This "Quality in the 21st Century: Perspectives from ASQ Feigenbaum Medalists" book is thus an additional contribution to the quality field, based upon the knowledge and experience of a set of quality professionals that have had the honor to be recognized, in an earlier stage of their professional life, for their contributions to quality and promising careers, as receivers of the Feigenbaum Medal, which is awarded "*for an individual 35 years old or younger, who has displayed outstanding characteristics of leadership, professionalism, and potential in the field of quality and also whose work has been or will become of distinct benefit to mankind*".

Starting in 1998, since then and up to this year 15 young quality professionals have been recognized with this award so far:

1998	Pedro M. Saraiva
2000	Daniel John Zrymiak
2001	Rajesh Jugulum
2002	Chris D. FitzGibbon
2003	Harriet Black Nembhard
2004	Denis Leonard
2005	Barbara J. Santiano
2006	Vivek Nanda
2007	Elizabeth A.F. Cudney
2008	Jeroen de Mast
2009	Kanthassamy Senthilmaran
2010	Jamison V. Kovach
2012	Paulo Sampaio
2013	Austin S. Lin
2015	Gurpreet Singh

This award had different impacts in their careers and lives, but we do have in common quite strong feelings about Armand Feigenbaum and receiving this recognition from ASQ, when we were all under 36 years of age, did mean and still means a lot to all of us. And it remains as one of our most important life moments of truth, that will be kept for ever in our memories, but also in our souls.

The book you are about to read thus aims to become a reference book in the field of quality, primarily based upon the visions of the Feigenbaum Medalists, which we hope will be able to help you (at least as much as it did for ourselves) "refresh" and "rethink" about quality and its future, making sure that you are a part of that future as well. In order to maximize readers understanding about the ways quality future is likely to be built, with insights coming from different parts of the world and those that are leading the way, this book thus tries to anticipate how and what the future

of quality is going to be, as well as how people and organizations can benefit from it and prepare for it.

Keeping that in mind, in order also to stimulate divergent thinking and creativity, no strict guidelines were provided, so that each contributor could get total freedom in expressing his/her own perspectives, within the scope of the book and its ambitions.

In the end, we feel quite fortunate to see the corresponding results, presented according to a very simple book structure, where individual contributions of Feigenbaum Medalists, including a brief short bio of each one of them is presented, together with some additional short insights (under a common template), and going across the book from the oldest to the most recent winners of the award. Finally, in a last chapter, we do, as editors, share a set of final conclusions, patterns, or considerations raised by comparing and going in detail over all the previous contributions covered.

Not all the Feigenbaum Medalists were able to provide their written contributions as authors of chapters, but even those are present anyways, through their short bio coverage. To all of them, we would like to give a special word of thanks. The “Quality in the 21st Century: Perspectives from ASQ Feigenbaum Medalists” book is a reality today because of you all, and derives mainly from your passion and creativity in the field, that we hope will keep shaping also the future that this book is all about.

As a final note, we strongly regret that the mentor of our award, who was with many of us at that occasion, is not here any longer, and thus unable to read, contribute, or criticize it, but we will never forget Armand Feigenbaum, who provided the world of quality with so many impressive inspiring contributions, and some masterpiece work performed at a relatively young age as well. As proud Feigenbaum Medalists, we believe also that this book will pay an additional tribute to him, promote his legacy as well as the ASQ award, hoping that some brilliant readers who are under 35 years of age will consider later on submitting their application to the award and also become possibly Feigenbaum Medalists in the future of quality.

We all know in quality that in the end a lot has got to do with how customers react to products and how much satisfaction these create on them. As a book on quality, we hope this also happens to be the case with our readers. And if you, as a reader, in the end do feel at least as satisfied as we as editors feel proud of the contributions collected, then this will become, as we hope, a quality book on quality. In particular, a special customer and reader also under this context is the person we pay here our tribute to: if Armand Feigenbaum were able to read the book and feel happy about it, that would be the best recognition that our effort and that of all the other authors has really been worthwhile and well converted into quality (and hope this might be the case, if he could still be here and share his knowledge one more with all of us, with comments made after reading the book).

Paulo Sampaio
Pedro Saraiva

Quality: From Past Perfect to Future Conditional

Paulo Sampaio and Pedro Saraiva

The 21st century will be the century of quality.

—Joseph Juran.

The future of something is quite difficult to define or predict. As Mark Twain stated, “the art of prophecy is very difficult, especially with respect to the future!” However, given the reduced value associated with forecasting the past, and the gains associated with estimating the future, it is worthwhile aiming to do so. And a good way to proceed with such a goal consists in properly indentifying improvement possibilities or new opportunities, and then defines strategies and approaches to address them. When we look into quality through this perspective, it is possible to anticipate that it will have a promising good future, built on top of its past and present achievements, provided that as a field it is able to adapt and move quickly into the future challenges raised by a fast changing world. In this chapter we will try to do so, based upon our national and international experience in the field, very proud of having been both awarded in the past as Feigenbaum Medalists from Portugal.

Quality Specific Roots

As opposed to what happened with the large majority of scientific or knowledge domains, quality “was not born” in the academia, but at first mainly derived from real-world applications, either in specific projects, companies, or other organizations. It was thus mostly from an hands-on experience that later on common grounds and conceptual developments of quality took place, namely those led by

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the so-called “quality gurus,” including namely Walter Shewhart, Edwards Deming, Joseph Juran, Kaoru Ishikawa, Philip Crosby, and Armand Feigenbaum, among others. These gurus, in different stages of quality development, contributed strongly to the birth and development of a body of knowledge representing quality in the twentieth century. Although one must not forget that quality is at least as old, in practice, as humankind, as portrayed in the wonderful book edited by Juran (1995). It has thus been the case that only later on, building from experience through mostly an inductive learning process, quality became to be addressed and adopted by universities around the world, where it has become a matter scientifically studied and improved. However, given this unusual roots, being born from the field to academia, even today it is still underestimated as a discipline standing by itself, demanding for its own teaching and research avenues namely at higher education institutions or in the way it is (or not) handled by the usual research financing agencies across the world.

Quality Geography and Scope

From a geographical point of view, the conceptual evolution of quality and its tools in the twentieth century was mostly driven by the USA and Japan, where concepts such as Total Quality Management, Six Sigma or Models of Excellence have emerged. Mostly since the 1980s, Europe has also played a significant role, although mainly focused around ISO standards implementation, as opposed to a more tools and pragmatically oriented approach followed by the USA and Japan. At the same time, quality has enlarged its scope of possible applications, and rather than being limited to industrial companies, has found usage in all kinds of organizations, including services, public administration, people, products, processes, or even territories.

But the world has been changing quite dramatically and quickly, both from a conceptual and geographical point of view, and also in the quality field. This change is here to stay and about to become even more demanding, taking place at rates that even the most prophetic futurists could not have imagined a century or two ago (Sanders 2008). Thus, quality becomes more critical than ever to address such challenges, and should assume a critical role as a strategic driving force for building success in the world of this century. It represents one of the few possible ways available to drive sustainable competitiveness and well-being in different regions and countries in such a global world, based upon the economic and social sustainable development paradigm (Saraiva 2008). A new and better world where things have also changed in the quality field from a geographical point of view, as can be illustrated by realizing namely that China is here to stay as the country with the largest number of ISO 9001 certified organizations, a significant number of researchers and research activities in the field, as well as one of the most ambitious national agendas for quality promotion in the coming decades, assumed by its central government, under a quality development plan for 2011–2020 aimed at having the country achieve a quality reputation leading position in the world before 2030.

However, as quality becomes increasingly global, and asking for increasingly larger international consensus regarding its development, one must also make sure that such an approach does not lead to inertia, lack of ambition, or speed in adopting needed progress and adapting to changing environments.

Quality in Depth

At the same time, and quite sadly, for some companies and people quality has been looked at as being just a “program,” “slogan,” or “fashion,” to which less attention is being paid given the financial crisis lived by many countries since 2008 or its replacement by other “management fashions,” such as innovation, also often seen from a quite shallow perspective. The worldwide evolution of ISO 9001 certified organizations corresponds partially to entities that do so only to seek registration as such and thus obtain a certificate, rather than a set of true organizational improvements derived from quality management implementation. When such standards are not properly understood and adopted, they may even lead to misunderstandings on what quality is all about, as pointed out, among others, by Juran, and it is quite important to notice that quality represents much more than any family of standards is able to cover.

For others, the process and systems based approach has been an awakening and organizations have started to realize that they can have a quality management system that could produce effective measurable competitive advantages (Childs 1997 cited in Shepherd 1998), something that is not really new for the quality field, if one remembers the early works of Feigenbaum, Juran, or Deming, where process and systems based thinking stand as a key pillar of quality management and quality engineering.

Quality Integration and Culture

As is also stated by Conti et al. (2003), quality needs to be seen as an integrated system, through which the best of all available approaches are merged into a single management system that engages the entire organization, rather than being seen as a single function or isolated department, separated apart from the overall organization mission and strategy. An entirely related operating philosophy and organizational culture should be developed by the management team as the core dimension of its way of working. Service quality will be a growing dimension, as the world becomes more and more technologically capable and customers can directly reach out to all competitors in a particular market, as shared economy phenomena become more and more common (e.g., Uber or Airbnb). Each customer therefore needs to be understood and treated as an individual with unique needs that must be identified,

properly addressed, and then reviewed to assure that he is always experiencing the level of service that he demands, or even more than that, by delighting him/her with some of the so-called (under the Kano analysis terminology) attractive product or service features.

In order for quality to be assumed through all the levels of any given organization or territory, it must be assimilated into the entire business or community system (or, even better, ecosystem) and, especially, by the entities top management, their management styles and practices, whereas continuous learning and improvement (both from an incremental and a disruptive point of view) must be increasingly valued by organizations and societies of the twenty-first century.

Quality Leaders

Based upon the work developed by Shepherd, back in 1998, we can also derive that quality managers of the twenty-first century should lead their organizations by using quality concepts to drive improvements and competitive advantages, going well beyond product compliance or meeting specifications. Their role should thus comprise the following inspiring goals (Shepherd 1998):

- Convert organizational improvement into levers to gain market share and volume by becoming a partnered supplier.
- Focus on improvements in the supply chain to address all areas of opportunity for improvement in time, cost and innovation.
- Seek to replace existing measurement systems with ones that truly address what is or should be managed.
- Participate in the concepts of organizational quality, including areas such as environmental management, social responsibility and the organization's role in its community and in the world.

In the past and still today, many organizations manage quality with a technical and/or procedural emphasis, including periodic upward reporting to senior management. However, we need the future to rely mostly in entities that keep maintaining these technical, operational, and procedural useful practices, but that are also able to see and realize that quality is also a fundamental strategy for achieving and maintaining competitiveness at the product, process, people, and organizational and/or societal levels.

Quality Value

We must realize and take into due account that buying patterns integrate increasingly quality with value. They thus demand that we approach quality as a fundamental discipline, measured by total value perception of the product or service as

seen from the customer perspective, which, however, takes also into consideration the end result coming from the overall organization, including delivery and maintenance networks that provide and support products or services (Feigenbaum and Feigenbaum 2004).

Additionally, companies that want to compete successfully must align their quality strategies with successful twenty-first century operations, by making a basic transformation of their management orientation and quality systems. Furthermore, companies committed to quality can no longer focus their quality programs primarily on the reduction of defects, but they must build their quality programs throughout the customer value chain, by integrating and connecting all key quality work processes. The same principles apply when we deal with future needs for addressing quality in the public sector, or as applied to societies seen at the local, regional, national, or even international levels.

Quality Anticipation and Improvement

It is thus not enough any longer for companies to understand what customers want. They must also try to anticipate what customers are likely to want in the future. Today it is also no longer enough to have a good product or service, because this is a mandatory requirement for remaining in the marketplace. However, many corporate leaders are not familiar or experienced with appropriate quality metrics and strategies (e.g., quality function deployment), neither do they realize or fully appreciate the benefits derived from systematically achieving and maintaining defect-free products and services or company improvements, on the one hand, but going beyond those levels of quality, on the other hand (this philosophy is well portrayed by the well-known example of a Japanese company that found it strange to receive an order asking for less than let's say 3 % of defects, and since it was already working under a defect-free environment coupled with a beyond-specifications quality view, supplied each 100 pieces together with a separate box, containing three non-complying units, manufactured on purpose for a customer still in the age of Acceptable Quality Levels for lot acceptance).

Quality Professionals

Even while the fundamentals and foundations of quality remain the same, environment, organizational culture, and tools which needs to be implemented have significantly changed when we look ahead and for quality as it needs to be foreseen in this century. Additional challenges facing the quality professional derive from

this evolution of quality, as well as from the impact of the four following primary trends that affect our worldwide economy (Gutner and Adams 2009):

- Globalization.
- Customer sophistication.
- Talent management and leadership issues.
- Environmental concerns and social responsibility.

Therefore, according to Gutner and Adams (2009), the skills needed to address and adapt to such trends affecting economies and societies, as well as show to companies' top management how quality tools can be used to address their own concerns and challenges, will determine how well quality leaders and professionals will be able to continue to make themselves relevant into the future, as well as the types of professional opportunities available, number of jobs in the field, and, last but not least, their corresponding wages.

Not only must the profession itself adapt, but quality professionals must also change and become increasingly strategic thinkers, skilled in new competencies, critical to address modern challenges. As we have stated elsewhere (Saraiva 2001), in the future good quality professionals should be able, in particular, to the following:

- Combine easily and efficiently both quality management principles together with sound quality engineering tools.
- Understand, at a multiscale and multilevel scope, how quality can be addressed at the product, process, systems, organization, or societal levels and move easily between different scales or scopes of quality application.
- Build adequate bridges between quality and other related fields, without leaving to others, eventually less well prepared, what should be their role in terms, for instance, of data analysis (and big data problems), innovation, or process management, product development, just to name a few.

Quality Feigenbaum Trends

In a book devoted to the future of quality, as seen from former winners of the Feigenbaum Medal, we pay tribute to him and what he represented to the quality field, but very deeply into our own quality souls, as editors from a small country (Portugal) that have been privileged to be recognized with this very prestigious award at a young age of our professional development and always inspired by him in promoting and building quality for the world.

It is thus inspiring, refreshing, and worthwhile going back to the legacy of Armand Feigenbaum, a clear visionary over the future of quality, who shared some key thoughts in his talk during the 52nd Annual Quality Congress, while presenting

his “Six fundamental vital signs of quality development” (Harrington 1999) as follows:

- Remarkable human behavioral change in the way of thinking about how they can improve the quality of the way they work at their jobs and they buy the products they use.
- Quality has become one of the most important management ideas.
- The new disciplines of quality cost economics.
- Quality has become an international business language.
- Widespread managerial recognition of the absolute and universal necessity for fact-based decision-making.
- Measurement of the business results of quality in serious and systematic terms.

Quality Trends

According to Watkins (2006), to be effective under the new contexts, quality management systems must evolve into key components of overall business management systems. As such, one must address and incorporate the whole organization and its management system focus on the use of knowledge to understand and deal with its ever-increasing dynamic complexity.

The role of quality as a function and profession therefore needs to evolve in both scope and orientation. Its scope needs to include the application of continual improvement systems, tools, and disciplines across the entire organization. Central to this goal are the practices involved in knowledge acquisition, management, and expansion (Watkins 2006).

By its own hand, the American Society for Quality (ASQ) has identified, back in 2009, the following four priority areas of focus for the future of quality and organizational excellence (ASQ 2009), which are still valid today:

- Emphasize strategic relevance and contribution to long-term sustainability.
- Connect with innovation.
- Increase public awareness and brand value.
- Use information technology and the movement toward engagement technology and tools.

Additionally, the following three alternative propositions were also identified:

- Quality and performance excellence are dead and passé.
- Quality and performance excellence are alive and well.
- Quality and performance excellence are neither dead nor alive.

The three scenarios underline that there are considerable risks associated with the future of quality, but also possibilities for building its bright evolution. The first scenario corresponds to a particularly tool-centric view of quality, using old tools to address new challenges, and thus not keeping pace with world changes, and in

addition with quality and performance excellence principles not being a part of everyday education, because quality management is not taught as pervasively as other management sciences. Concerning the second scenario, it corresponds to an evolution where quality and organizational excellence are strategically relevant and leading to organizations' long-term success and sustainability, and therefore they build an atmosphere of exploration and adoption of innovative models, so that rather than dealing with quality strictly under mechanistic terms they transfer and share information, knowledge, and experience. Under the third scenario, quality and performance excellence suffer from an image problem, surviving but not being recognized a critical strategic choice for the world well-being, or as important as other related fields, eventually more in fashion, such as innovation, creativity, or entrepreneurship.

We all, as members of the quality community, need to find out and do what needs to be done in order for the second scenario to become the real one across the world, since we have, as individuals, organizations, and societies, a lot to gain if this is indeed the scenario that prevails.

Quality Driven by Communities

Another issue that needs to be overcome, regarding the branding, meaning, and image of quality in the twenty-first century has to do with the ways that will be followed in times where, as ASQ has stated, its "age of the gurus" may have ended with the passing way of the twentieth-century quality leaders, that we all miss, and in the context of this book obviously with a very special tribute to the contributions of Armand Feigenbaum.

We need to overcome this proud sense of orphanage, but realize that the best way of acknowledging all the legacy from these heroes, and certainly they would like quality to move ahead, corresponds to actively renewing it as a field, but now within the context where an age of collective wisdom may have arrived, as is the case with most of the domains of knowledge. There is potential for breeding, recognizing, and promoting the creation of never-ending new generations of quality professionals that keep emerging and contributing with new principles, concepts, approaches, and tools, while recognizing and accepting that quality in the future is unlikely to be any longer "guru driven," but rather become very much "community driven."

And look into this evolution as being a very positive one, and the best recognition one might have for the levels of maturity is that quality has achieved status as a discipline. Such a recognition for young promising individuals, under 35 years of age worldwide, corresponds to the main goal that the Feigenbaum Medal tries to achieve, and motivated us to put together this book, as a collective effort that combines contributions received from such individuals on how they look into the future of quality, from a broad range of insights, perspectives, and experiences.

One can see that such fresh views, coming from a sample out of a total of 15 Feigenbaum Medalists so far, come from people with a variety of backgrounds and geographical origins, related of course with the USA, but also Canada, Portugal, India, and Netherlands.

Quality Technology, Projects, and Costs

Technology and technology-driven innovation, competitiveness, and entrepreneurship are also playing an increasing role in modern societies and organizations, which will in the future evolve over time strongly stimulated by the catalyst of technological change, which makes possible for them to choose new directions, address new realities and business goals.

Thus, the main challenge for quality professionals of the future in this regard will be to become knowledgeable of critical technology developments and make good use of them, thus acting as change managers, as a key component of their duties. As quality becomes also more expressed as a management concept, it will become also imperative for quality professionals to learn and embrace this knowledge (Conti et al. 2003) and the relationships between quality, quality costs, and bottom-line results.

Apparently there seem to be two future promising areas for the development of quality professionals, comprising on the one hand the technologically oriented approach, with more emphasis on statistical thinking, quality engineering and good use of new technologies, and, on the other hand, the project management approach, aimed at building organizational change within the scope of its changing business processes and environments, in a culture that becomes more project oriented than department oriented.

Regarding new technology-based developments, we need to come up with a more ambitious agenda, since in the quality field there seems to be up-to-date only room and collective capability to come up with a new disruptive contribution in every decade or so, rather than every year or so. Then, more incremental “kaizen” inspired refinements take place, but should not replace the birth of new generation of concepts and solutions, which we should strongly promote, namely through much larger and wider mechanisms to support R&D projects in the quality field, supported by companies, higher education institutions, and public agencies.

Additionally, non-quality related technology developments should be surveyed, explored, and made good use of by the communities of quality professionals, rather than leaving such opportunities strictly for other professionals, less well prepared for doing so (e.g., innovation, big data, or new product development are frequently addressed by people and teams that do not include quality experts), thus wasting all the potential, implementation, and added value that quality would otherwise bring to projects in these areas.

In particular, and more from a technology user perspective, the advances made in information and communication technologies have made possible for easy

exchanges and collaborations among quality professionals of different backgrounds and geographies. As was once properly stated, in this sense one can say that as we use more and more e-quality, more and more equality is achieved. New results, trends, access to information, and knowledge are now available, at the same time and under mostly equal conditions, to all interested quality professionals, who may also participate in international collaborations and share their results on a common worldwide basis.

Quality Measurements

As an additional remark, in thinking about the future of quality, one should never forget what was once stated by Lord Kelvin: “if you can not measure it, you can not improve it.” Therefore, quality development must take place at the same time that we make good use of proper metrics, instrumentation, and measurements, including those related with new scopes of application (e.g., nanotechnology, big data, genomics), but not only dealing with measurements of physical realities, but also taking into consideration that today we have available a good set of tools under what we have called the “perceptions metrology,” in a sense that we know how to measure accurately with well-defined levels of uncertainty people’s opinions and feelings, as developments in sensorial panels, customer or employee satisfaction characterizations have shown in the past years (Saraiva and Reis 2009).

Quality Projects

An interesting project, being developed mostly with International Academy for Quality members and conveying an European strong contribution, concerns the definition, testing, and implementation of a single integrated conceptual model for defining and conducting improvement projects (Andersen et al. 2015). We believe that within the context of the concerns and challenges that lie ahead of us, in terms of quality development and its future, this initiative can be quite emblematic (though only time will show if its real impact corresponds to such expectations), given that it simultaneously:

- Moves from the guru-based paradigm to the international community driven paradigm, through a shared scientific contribution that is resulting in a single, universal, and consensual model for structured improvement, aimed at guiding organizations and their teams in proper identification and implementation of improvement projects, built not from scratch but from a detailed comparative analysis and benchmarking supported on previous relevant quality approaches, then refined by a team of quality professionals.

- Derives mostly from European contributions and views, as opposed to major conceptual developments of quality in the twentieth century, that were mostly created with origins either in the USA or Japan, thus showing that the future of quality is likely to be connected with a much wider variety of geographical locations and origins, whereas particularly in Europe we hope that organizations such as EOQ, EFQM, and ENBIS are expected to play an important role.
- Shows the relevance of defining and adopting well-structured and systemic approaches for building quality on a project by project basis, keeping the circles of quality development moving fast, strongly and in a determined way into the future.

Quality ASQ Trends

In order to define the future of quality, one must not forget some of the efforts led by ASQ in this regard across the years. In particular, its research project “The Global State of Quality Research” (2013) highlights that the best quality management organizational structures are the ones that include quality management principles and practices leading to a maximization of organizational results.

Explanatory key factors and trends that have been found and established are as follows: (1) There are significant differences in the use and application of quality management and practices across organizations, depending on their sector of activity. (2) There is a general idea pointing out that larger organizations tend to use more mature quality practices, and although this idea is appropriate for various practices, in general the size of the organization is less important than its activity sector concerning the application of mature quality practices. (3) There is no relevant indication that the use of quality principles and practices differs substantially according to regions or different countries, since some variations do exist, but normally they are related to organization activity and size, or other unidentified factors, more than having to do with its geographical location, thus confirming that quality has become indeed global and universal in the ways it is being defined, built, and implemented.

Quality Management

Quality management has been defined as a “philosophy or an approach to management” made up of a “set of mutually reinforcing principles, each of which is supported by a set of practices and techniques” (Dean and Bowen 1994). Today, quality management is a well-accepted organizational goal in many entities, with proven results. Quality management has thus been considered an important strategic

management tool over the past decades, involving the application of principles and practices of quality at all levels of the organization (Talib et al. 2011).

As time goes by, and we move into the future, quality management must be focused and considered a broader set of issues, ranging from sourcing activities all the way to final product delivery and after-sales service, but not forgetting social responsibility, expectations, and needs from a variety of relevant stakeholders. Furthermore, quality management is characterized by the constant search for continuous improvement, in order to achieve excellence and to attain efficiency, sustainability, and competitiveness (Oakland 1993; Terziovski 2006). Under the quality management concept, companies can improve their organizational performance and business, customer and employees' satisfaction, relationships with suppliers and positive attitudes, by improving organizational quality culture (Talib et al. 2011; Reed et al. 2000). The study conducted by Sousa and Voss (2002), commenting on the validity of quality management, concludes that, "quality management, as espoused by its founders, can be reliably distinguished from other strategies for organizational improvement and there is substantial agreement in the literature as to which practices fall under the quality management umbrella."

Based on some of our previous research (Barros et al. 2014), we were able to identify an exhaustive list of quality principles and practices that are currently used by quality-driven companies worldwide and can be summarized as follows:

Quality Principles

- Leadership.
- Customer focus.
- Employee involvement and commitment, including top management.
- Human resources management.
- Strategic planning management.
- Process management.
- Supply chain management.
- Continuous improvement and innovation.

Quality Practices

- Quality tools.
- Quality standards.
- Business and operational excellence models.

Culture of Quality

However, the successful use of such quality management principles and practices is significantly influenced by the culture of quality that must exist in the organization. It is thus not good enough for an organization to have the best technology or adopt the best available management practices, but it needs furthermore to be engaged and truly committed to a quality culture.

The success of quality programs and initiatives therefore depends mostly on the existence of a culture of quality. Many organizations assume quality slogans but true effectiveness requires an accompanying commitment to various cultural elements such as leadership, a compelling vision, companywide shared values, pervasive behaviors, complementary performance metrics, incentives, and goals. It is only when an organization exhibits these and related components that it can be said to exhibit a true culture of quality (ASQ 2014). There are a lot of organizations worldwide using tools and methodologies of quality without being engaged with a true culture of quality. That is often the case of companies that implemented ISO 9000 standards just because someone above them in the supply chain demanded for it. Those companies are using the quality tools because someone told them they have to. They thus did put some procedures into practice and then, once a year, have compliance audits. But since there is no real sustained commitment to quality, and there is no culture of quality, they do not attain anything close to the full value associated with standards, when they are properly used.

Elements such as vision, values, and leadership help establish and guide such a culture of quality, which can also be applied in our individual lives or at the level of communities, regions, or nations. But there is yet another critical component of a quality-focused culture—the commitment with customers (ASQ 2014). Such a commitment to customers must lie at the heart of any quality program. But this in turn outlines a fundamental ongoing challenge for any organization that is continually and accurately discerning true customer needs. To do the right things, companies need to closely understand their customers.

Quality Bottom-Line Results

World-class companies are investing more heavily than others in both overall and technology-specific quality investments. However, quality people speak a different language from the C-suite. Quality professionals usually speak in technical terms about processes and defects and the CEO (and other senior executives) speak in financial and profitability terms. What needs to happen is that we need to translate defects and process improvements into dollars and euros, and then, when this happens, the C-suite will be more open to the pursuit of quality, and quality costs have been and are likely to become even more so in the future a sound bridge for joining both of these semantic worlds.

Quality of Management

The overall state of an organizational culture may be intangible. But the value of taking steps to shift the company or institution towards a more quality-driven culture can be substantial. Organizations should therefore incorporate the lessons outlined above to accelerate growth, performance, and results (ASQ 2014).

Therefore, in the future one must be fully aware that quality management is going to become more also connected with a management of quality, and within such a paradigm quality represents simultaneously a pragmatic view but also what we have called before as being also in some regard the “Management Poetry.”

Quality ASQ Future Studies

As stated before, when one wants to talk about the future of quality, several studies led by ASQ must be taken into account. On a regular basis, ASQ publishes its Future Studies, with the aim of defining a set of recommendations, evolution perspectives, and directions concerning the future of quality and its implications. According to Watson (2009), the aim of the ASQ Future Studies is to study the future in order to make better decisions about how to prepare it.

The last published study (ASQ 2015) highlights a set of recommendations for the future, based on different perspectives—Leadership, Aerospace and Defense, Manufacturing, Cities, Healthcare, Education, among others. Bill Troy, ASQ CEO, in his “Introduction” section points out that quality will play an integral role in all of the areas and furthermore identifies the following common ideas among the different contributions to the study:

- We need to knock down silos of information in order to get the right information to the right places.
- We need to think differently about things that we assume we already know quite well.
- The implications of limited connectivity will change how we think and how we do almost everything.

Quality Importance

Why is quality an important issue in the present and will become even more important in the future? There are a lot of different reasons that could be mentioned in this regard. However, in our opinion, the following issues are particularly relevant in the twenty-first century:

- Customers are becoming more demanding and better informed than ever before.
- Our life increasingly depends on the proper functioning of quality products and services.
- The world is global and will remain this way.

To cope with such an environment and world, one needs to make proper use of quality principles, methodologies, and tools, at the same time that new concepts are developed and quality R&D projects are nurtured; also sharing the same underlying pillars of the quality discipline, which are as valid today as they were in the beginning of the last century. However, we need also to reinvent approaches, update definitions, and adapt them to the current world, and mainly to the world and organizations of the future.

Quality Performance

Snee and Hoerl (2015) identified the following five specific advances that are needed in order for companies to improve their performance in the future:

- Holistic improvement approaches.
- Identify and solve mission-critical problems.
- Use big data to generate new knowledge.
- Human variation.
- Use innovation to create new jobs.

Quality Scope

Quality should be, in the future, no longer only focused on organizations, but rather cross all the frontiers of the organization supply chain, and addressed also at the societal levels.

Quality management and supply chain management are management philosophies that play an important role in strengthening organizational competitiveness (Talib et al. 2010). The integration of these two concepts is one of the most important organizational paradigms for the twenty-first century organizations—supply chain quality management “is the formal coordination and integration of business processes involving all partners organizations in the supply channel to measure, analyze and continually improve products, services and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace” (Robinson and Malhotra 2005).

Supply chain management assumes a methodical and integrative methodology to manage all the operations and relationships between all the stakeholders of the supply chain. From the perspective of quality management, supply chain management should be recognized as providing quality products and services across

every organization in the supply chain, to address client's expectations. The synergies of quality management and supply chain management can promote the integration of the approaches which will promote a set of significant organizational benefits (Fernandes et al. 2014).

Thus, over the years, the quality concept is becoming increasingly globalized and holistic, and therefore implying more complex challenges for organizations. Rather than just formal issues, the future of quality should mainly be based on specific actions that must be implemented in the organizations—"Quality in Movement" (Saraiva et al. 2010). The future of quality mostly depends on the implementation of quality in the organizations, supported by a true culture of quality. To do so, some critical success factors should be considered (Saraiva 2000; Saraiva et al. 2010), mainly the following:

- Everybody's involvement and commitment, not only in the organization but also through the value chain.
- Credibility of the quality concept.
- The quality concept should be fully assimilated by all.
- Organizations should be truly committed to quality.
- A strong leadership and top managers' role are of crucial importance.
- Credibility of quality training.
- Promote research on quality.
- Relationships between innovation and quality explored.

Regarding in more detail connections and bridges that can be established and explored between quality and innovation (Saraiva and Orey 1999), this particular interface has a lot to gain if we, as quality professionals, take advantage of how quality can drive innovation and innovation can drive quality efforts, something that has been so far clearly underestimated and not fully understood.

Quality at the Country Level

As a pioneering effort in drawing the future of quality for our own country (Portugal), we have conducted a project sponsored by APQ (Portuguese Association for Quality), with both qualitative and quantitative components, and wrote a book about it (Saraiva et al. 2010). Under the Structural Equation Modeling paradigm, we did come up with statistical results that identify the key driving forces for the future development of quality in the nation (Fig. 1), where we can mention in particular the following results (on a 1: lowest performance to 10: highest performance scale of measurement, and positive impact coefficients ranging from 0 to 1):

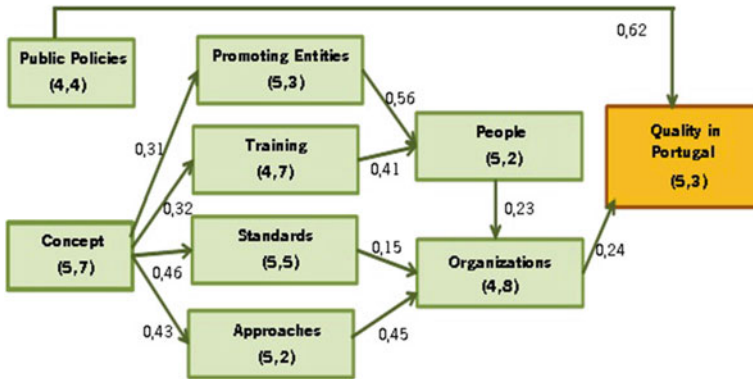


Fig. 1 Structural equation model for the future of quality in Portugal (Saraiva et al. 2010)

- Public policies play a key role and have a direct impact over the global level of quality achieved in Portugal.
- The real approaches adopted and the way tools are used end up being more important than the exact frameworks adopted for quality implementation.
- A proper understanding of quality concepts should drive all quality efforts.
- People training and involvement are critical in order to achieve organizational quality improvements.
- Around 20 practical recommendations for action, based upon such results, were identified as being essential to reinforce national quality levels in the future.

Quality Worldwide

Moving now from national to international perspectives, it is our opinion that a “Worldwide Agenda for Quality” is needed, joining together the most important institutions in the area working together to reach common goals and share best practices. Some attempts have been made in the past under this spirit, but without the deserved successful results. However, we are still having time to do it and to build a smiling future for quality through international joint efforts, rather than having separate and somewhat redundant efforts going on (e.g., do we really need similar but different models of excellence applied in different parts of the world, rather than having just a single unified framework, as is the case with ISO standards?).

Quality Mindset

Using the words of Cecilia Kimberlin 2015, ASQ Chair, in the twenty-first century quality must be an organizational mindset. Quality of the twenty-first century must be imbedded and fully integrated in the organizational and societal cultures, where leaders assume a fundamental role and embrace quality as an enabler for success (ASQ 2015). Quality should be continuously understood, assimilated, and implemented, both in public and private organizations. However, each one of us is responsible to push and pull quality forward, doing always well, better, and differently (Saraiva et al. 2010).

Quality Conclusions and Commandments

There will only be a future of quality. We hope it will be a positive and fruitful one, but all of us must work for that to be the case and become a reality, namely by combining two areas that are not so easily brought together (Quality Engineering and Quality Management) but are essential for building such a bright future.

Let's take advantage of a remarkable past and build a better world with quality for the benefits of present and new generations, with quality professionals playing a key role and being recognized as critical change agents, taking into account, as final summary thoughts, that is, as stated above, the following 25 commandments (by alphabetical order) should inspire us in this forthcoming journey guiding and determining quality's future:

1. Quality development and its contributions to the world require its education and training to become universal and applied to people of all ages and backgrounds.
2. Quality developments need to be built from internationally reached consensus, but be also ambitious and fast enough to cope with changes in the world.
3. Quality for value, with new quality costs and other related approaches, should be a priority and facilitate dialogue with senior executives.
4. Quality has a lot to gain by adopting a multiscale and holistic view, ranging from the product nanoscale to societal challenges defined at world level.
5. Quality in the future should be able to come up with customized problem definitions and tailor-made solutions.
6. Quality is and will be global regarding solutions, concepts, best practices, tools, information, learning, and knowledge sharing.
7. Quality management and quality engineering must intertwist each other and the integration of both of these legs will make it walk into the future.
8. Quality may have a decisive and bright future ahead, to be achieved through hard work and not taking its success for granted.
9. Quality mindset should move from a specification-oriented framework into a continuous improvement mode, including innovative steps aimed at delighting people.

10. Quality must be able to anticipate what is going to happen with customers, stakeholders, and societies as a whole, and contribute to those changes.
11. Quality must explore technological developments as they raise new opportunities, as well as help in making the field more efficient and useful.
12. Quality must not only be kept being built from experience to academia, but also in the reverse direction, from academia to the fields of practice.
13. Quality must move from a “departmental perspective” into integrated, systemic, and well-structured views and also be “project driven”.
14. Quality needs to become, be seen, and recognized as a fully matured field of knowledge.
15. Quality needs to nurture and come up with better and more frequent quantum leap moves and be able to come up often with disruptive evolutions.
16. Quality needs to reinforce its interfaces with other related fields, namely innovation, product development, statistics and big data, social responsibility, and creativity.
17. Quality R&D must be reinforced, namely through projects in this field, accepted as such, just like other scientific areas.
18. Quality should aim not just at satisfying but rather at delighting different sets of stakeholders, namely by anticipating how to go well beyond existing expectations.
19. Quality should be able to measure well, what really needs to be measured in order to improve and drive changes, including good perceptions oriented “metrology” applications.
20. Quality should be addressed, defined, and implemented at different levels, including products, processes, systems, people, organizations, services, supply chains, and societies
21. Quality will lead more and more towards real equality as more and more e-Quality facilitates access to information and knowledge share.
22. Quality will move from being “guru driven” into being “community driven,” namely regarding its development, concepts and tools validations.
23. Quality will relate strongly with organizational culture and societal views of the field and its contributions to the success of regions and countries.
24. Quality’s future is also a matter of public policy choices, branding, training, population, society awareness, and knowledge.
25. Quality’s future needs to get away from slogans or shallow approaches and be consolidated around deep knowledge, foundations, culture, and developments.

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Author Biographies



Author's Short Bio and Perspectives

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Education: Industrial Engineering Degree (2002, University of Minho, Portugal); PhD in Systems and Production Engineering (2008, University of Minho, Portugal).

Current Job: Assistant Professor of Quality Engineering and Management, University of Minho.

Previous Jobs: (2002–2004) Project Manager, Portuguese Association of Certification; (2004–2008) PhD Student (with a full scholarship from the Portuguese Foundation for Science and Technology).

Introduction to Quality: In the third year of my Industrial Engineering Program, in the Quality Management course, by

Prof. Tavares de Oliveira. In that moment I decided that quality would be my professional field.

Favorite Definition of Quality: Give the customers what they want!

Major Contributions to the Field: When I am working with my students and my researchers with the aim to develop and promote quality as a science and as a strategic area for the organizations.

One Word Defining the Future of Quality: Challenging

One Trend Defining the Future of Quality: Global

Impact of Feigenbaum Medal: It was the most important moment of my professional life. It was the recognition of my work by the most important global institution on quality—the American Society for Quality, and of my role as a Quality Professional. Being recognized gave me more will and inspiration to grow and to learn as a Quality Professional. Personally, it was also a very important moment with a lot of meaning—Pedro Saraiva, my *Sensei*, is the first Feigenbaum Medalist.

Favorite Book on Quality: This one! (I wrote this before check Barbara Santiano bio!)

Three Publications:

“Quality and the ISO 9000 Standards: myths, true and consequences”, Verlag Dashöfer, Lisbon, 237 pp., 2011.

“ISO 9001 Certification Research: Questions, Answers and Approaches”, International Journal of Quality and Reliability Management, Vol. 26, No. 1, pp. 38–58, 2009.

“The path to excellence of the Portuguese organizations recognized by the EFQM Model”, Total Quality Management and Business Excellence, Vol. 25, No. 5, pp. 427–438, 2014.

Plans for the Future: Being better than today.

Quality Quote: “A better world with Quality!” (International Conference on Quality Engineering and Management quote, which I founded).



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Previous Jobs: Vice-Rector of the University of Coimbra in charge namely of Quality, Innovation, and Entrepreneurship

President of the Development Agency for the Central Region of Portugal

Consultant of the Portuguese President for Higher Education

Founder of several organizations and quality consultant

Introduction to Quality: When I was born, although not realizing the name of it

Favorite Definition of Quality: Doing well and better what really needs to be done

Major Contributions to the Field: Teaching, research, consulting, listening, and writing about quality and contributing at different levels to its promotion and application in different contexts including less usual ones

One Word Defining the Future of Quality: Uncertainty

One Trend Defining the Future of Quality: Evolution

Impact of Feigenbaum Medal: I still remember quite well when Subir Chowdhury told me the good news, as one of my happiest life moments of truth. This helped a lot in establishing international contacts and meeting a number of brilliant people, namely later on as member of the ASQ Feigenbaum Medal committee. But also the opportunity to meet in person and talk with Armand Feigenbaum. My dedication to the quality field, after having been the very first recipient of the award has been always quite strong but was since then inspired and reinforced by this fact that I always keep in mind. Receiving this recognition as a citizen of Portugal has also shown to me that e-quality leads to more equality in the field, since you can have now access to the quality world and contribute to it regardless of geography or the size of your country.

Favorite Book on Quality: Juran's last edited book "A History of Managing for Quality: the evolution, trends, and future directions of managing for quality"

Three Publications: Entrepreneurship: from concept to application, idea to business and technology to value, book published in Portuguese by Coimbra University Press, Third Edition (2015)
Chemical Product Design and Engineering, chapter of the Kirk-Othmer Encyclopedia of Chemical Technology, 6th Edition, published by John Wiley & Sons (2015)

The future of quality in Portugal book published in Portuguese by the Portuguese Association for Quality (2010)

Multivariate and Multiscale Data Analysis, chapter of Statistical Practice in Business and Industry, book published by John Wiley & Sons (2008)

Plans for the Future: One day at a time, with today being better than yesterday but worse than tomorrow

Quality Quote: Just do it!

Importance of Data Quality for Analytics

Rajesh Jugulum

Introduction

As we know in this highly regulated environment, there is an ever-increasing need in creating and providing safeguards and tools to increase the transparency and accuracy of information. Such tools and mechanisms also need to satisfy business and regulatory requirements. This situation has significantly increased the role of data and analytics in business in general. Data and analytics capabilities should be viewed in the same way as other resources such as people, facilities, raw materials etc. Therefore, data and analytics capability management aspects have become critical functions in managing overall business and achieving business excellence. In this chapter, we will discuss the importance of data quality to perform high-quality analytics and take appropriate decisions basing on the analytics.

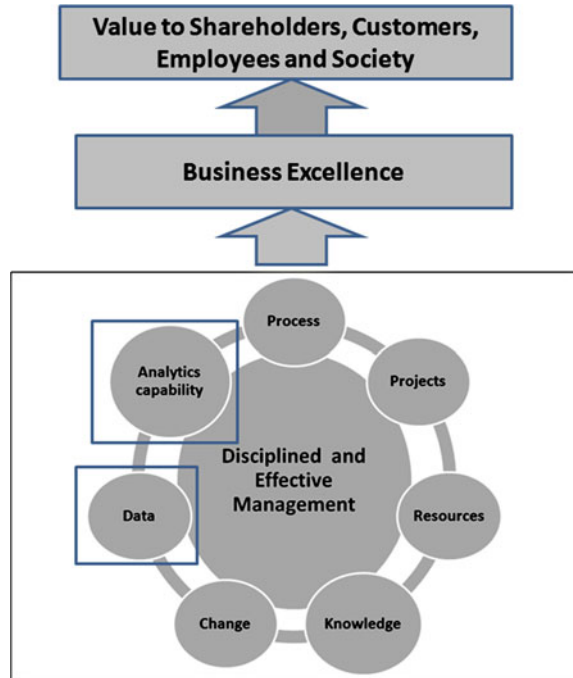
Data and Analytics as Key Resources

Harrington (2006) highlights the importance of managing processes, projects, change, knowledge, and resources for organizational excellence. In addition to these, in this data-driven world, importance of data and analytics capabilities cannot

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Fig. 1 Seven levers of a disciplined and effective organization



be overlooked. Because of the importance of data and analytics to derive insightful business outcomes, data and analytics capability management aspects have become critical functions in managing overall business and achieving business excellence.

Figure 1 shows seven levers of a disciplined and effective organization. Besides having good processes, projects, resources, great knowledge, and ability to change, we need to have capability to ensure high-quality data and ability to perform high-quality analytics to survive in the global competition and they have to be viewed like any other resources. Therefore, it is important to ensure that we have high-quality data across the organizations to derive meaningful business outcomes.

Importance of quality data was emphasized by famous statisticians much before the data quality field has experienced massive growth both in industry and academics. R.A. Fisher, a famous British statistician, said that the first task of a statistician is to conduct the cross-examination of the data for meaningful analysis of data and interpretation of results. C.R. Rao, a world-renowned Indian statistician provided a checklist (Rao 1997) for cross-examination of the data, where emphasis was primarily given to the data quality and measurement systems that we use for data collection.

Measuring Data Quality

To measure the level of data quality (DQ), we need to select the DQ dimensions of relevance to the specific business process. A DQ dimension, as defined by Wang and Strong (1996), is a set of DQ attributes that represent a single aspect of DQ. In Table 1, we list four core DQ dimensions that are typically used. After defining the DQ dimensional definitions, they are translated into set of business rules to measure the levels of DQ and reliability. DQ business rules help us quantify how good or how bad the data is. By applying the DQ rules to critical data elements (CDEs), we classify them as good or bad in the context of a chosen dimension. A critical data element can be defined as a data attribute that is “critical to success” or required to get the job done. Examples of CDEs are social security numbers, customer ids, data of birth, seniority of claim etc.

Let us assume that the CDE “Seniority of claim” always takes a two-digit value, the valid values of this CDE are restricted and they can be mapped to: Seniority of Claim Code-Senior Secured, Senior Unsecured, Subordinated Secured and Subordinated Unsecured.

We map this business rule to DQ rules for different DQ dimensions:

Data Quality Rule: The CDE “Seniority of claim” takes values from the set {10, 20, 30, 40}. As a result, this CDE is valid and its validity is 100 % as it takes predefined values. This rule maps to the validity dimension of DQ and similarly with other rules we can determine scores for other dimensions. After defining business rules, we perform profiling to understand the behavior patterns of CDEs, and after this step we can calculate DQ scores for CDEs.

Table 1 Four-core data quality dimensions

Dimension	Definition
Completeness	Completeness is defined as a measure of the presence of core source data elements that, exclusive of derived fields, must be present in order to complete a given business process
Conformity	Conformity is defined as a measure of a data element’s adherence to required formats (data types, field lengths, value masks, field composition, etc.) as specified in either metadata documentation or external or internal data standards
Validity	Validity is defined as the extent to which data corresponds to reference tables, lists of values from golden sources documented in metadata, value ranges, etc.
Accuracy	Accuracy is defined as a measure of whether the value of a given data element is correct and reflects the real world as viewed by a valid real-world source (e.g., SME, customer, hard-copy record, etc.)

Measurement of Data Quality Scores

Once we have selected the DQ dimensions and measured them using associated DQ rules, the measurement results are called DQ scores. DQ scores are the direct indicators of the performance of the data. A DQ score may reflect the quality of the data at a certain level. In particular, it can be a score for a given DQ dimension of a CDE, an aggregated score of multiple DQ dimensions of a CDE, or even an aggregated score of multiple CDEs (across all related DQ dimensions) at either the taxonomy or business unit level or the enterprise level. A DQ score is a percentage between 0 and 100. It can be generally interpreted as the percent of nondefect data entries out of all data entries.

DQ scores at multiple levels need to be computed in a logical manner. In other words, we cannot get a DQ score at the CDE level without first getting DQ scores at the DQ dimension level. Similarly, we cannot derive a DQ score at the taxonomy or business unit level without first getting DQ scores at the CDE level. This is why we need to determine DQ dimensions and the related DQ rules first. They are used to profile the data and to calculate the DQ scores for different DQ dimensions. Once the dimension level scores are available, DQ scores at the CDE, taxonomy or business unit, and enterprise levels can be derived accordingly. Figure 2 describes the roll-up process that can be used to obtain DQ scores at various levels.

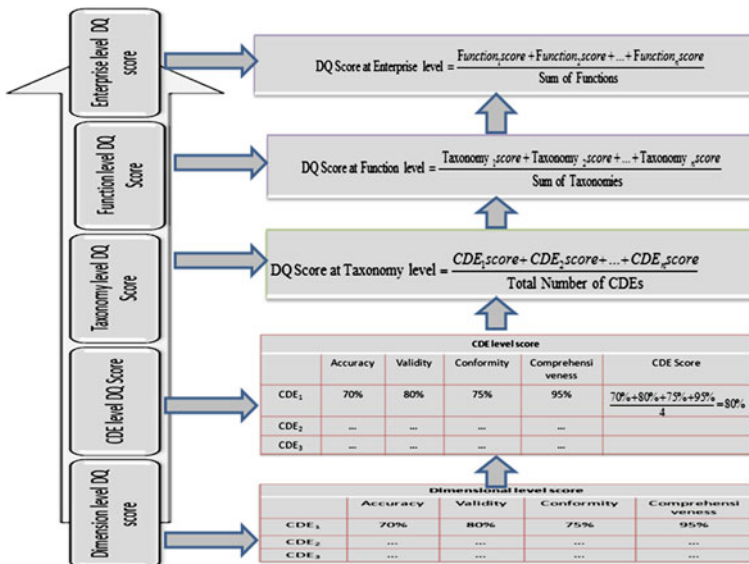


Fig. 2 Data quality scores at various levels

Different Types of Analytics

In this competitive world, the importance of having new insights with data and proper analytics to understand the customer expectations in a much better way has been emphasized by many organizations. There are different types of analytics and they can be chosen depending on the purpose. Gartner (2012) proposed an analytics ascendancy model that shows how the value of analytics increases as we expand the capabilities. Table 2 shows different types of analytics including the types that Gartner proposed. Note that the tools associated with these analytics may overlap depending on the case we are addressing. A brief description of all these types of analytics is provided below:

Preparatory analytics: This type of analytics can also be called as cross-examination of data and is useful to evaluate existing DQ levels for variables/CDEs. Techniques like DQ business rules, DQ rule evaluation, and statistical process control are useful to assess the DQ levels.

Descriptive analytics: If we want to know what happened to particular process, operation, facility or CDE, we should perform this type of analytics by using tools like data mining, basic profiling, and descriptive statistics. This type of analytics helps us to understand the performance at a given time point by providing a snapshot with means and standard deviations.

Diagnostic analytics: Diagnostic analytics are performed to know when, where, why, and how a particular problem has occurred. Techniques like correlation analysis, hypothesis test, analysis of variance (ANOVA), and control charts are typically used in this type analytics.

Table 2 Different types of analytics

Purpose	Type of analytics	Tools/techniques
How good is the data?	Preparatory analytics	Data quality rules, data quality scores, statistical process control etc.
What happened?	Descriptive analytics	Basic profiling, data mining, descriptive statistics etc.
Why and when it happened?	Diagnostic analytics	Control charts, analysis of variance, hypothesis tests etc.
How did it happen? (root cause analysis)	Cause-related analytics	Cause and effect analysis, failure mode effect analysis etc.
What will happen?	Predictive analytics	Artificial neural networks, regression analysis etc.
How can we improve?	Prescriptive analytics	Design of experiments, simulations, scenario planning etc.
How confident can we be?	Reliability-based analytics	Failure analysis, confidence intervals, signal-to-noise ratios etc.

Cause-related analytics: Cause-related analytics are usually performed to identify the causes of the problems or failures. Tools like cause and effect diagram, cause and effect matrix, and failure mode effect analysis (FMEA) are used to perform cause-related analytics.

Predictive analytics: Predictive analytics, as the name suggests, are useful in predicting the behavior of a process, system or CDE. Because of this reason, this class of analytics can also be called as “what-if” type of analytics. Techniques like Artificial neural networks and regression analysis are useful to perform predictive analytics. Simulation analysis plays an important role here as it helps simulate various scenarios and perform what-if analysis.

Prescriptive analytics: Prescriptive analytics are useful in answering questions like how we can improve the performance. Tools like designed experiments, simulation analysis, and scenario planning are extremely useful in this class of analytics.

Reliability-based analytics: Reliability-based analytics are typically used in estimating reliability of a product or process or systems or set of models so that we can be more confident about results. With reliability-based analytics, we can assign a confidence level and failure rate for the performance. Failure analysis, confidence intervals and, signal-to-noise ratios etc. are usually used in reliability-based analytics.

It is important to note that the analytics types in Table 2, can be used with numerical, text, voice, web-based, or social media-related data with appropriate transformations/modifications. They can also be used in the context of big data.

Requirements for Executing Analytics

As described above, depending on the purpose we should be selecting appropriate set of analytics. In order to perform the analytics across an organization, it should have “analytics vision” to start with as shown in Fig. 3. Once we have a clear

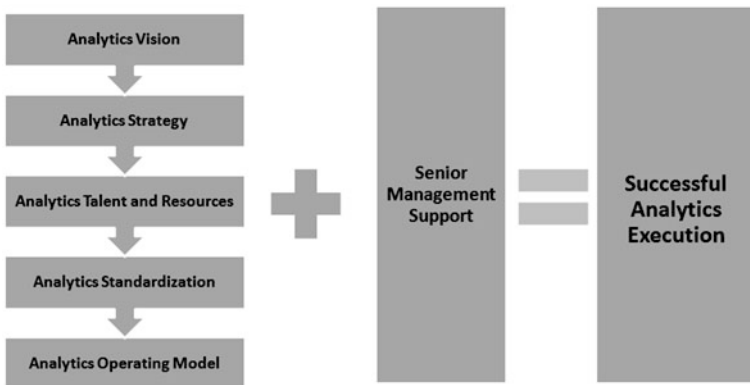


Fig. 3 Successful analytics execution

vision, we can design a suitable strategy for executing analytics. After this step, we should be looking at the talent and resources that we have for analytics. If there are gaps, we should start acquiring great talent and appropriate resources as part of investment strategy on analytics.

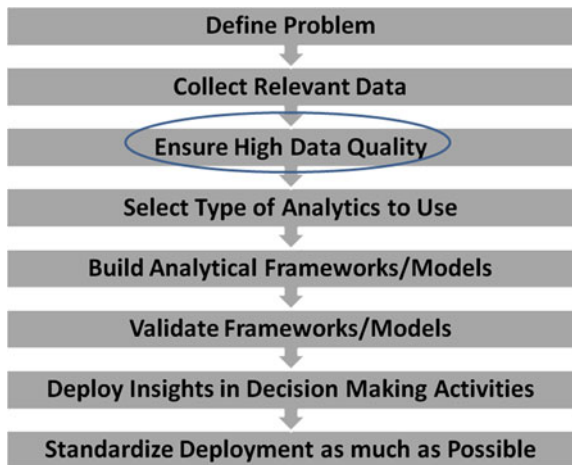
When we are planning to expand the use of analytics across the organization it is important to have a standardized approach along with an operating model for successful execution. Standardized approach helps us to use appropriate type of analytics in a given scenario although the tools may vary from application to application. The operating model comes in handy when we want to know how to deploy different types of analytics, associated methodologies, and interpretation of results etc.

In Fig. 3, it is needless to say that the most important requirement for analytics execution is senior management support. All other requirements cannot be fulfilled without the commitment from the senior management. After satisfying analytics requirements, the next stage is to define a process for execution. Next section outlines such a process.

Process of Executing Analytics

The first step in this process is to define the problem (as shown in Fig. 4) and understand purpose. Then we need to collect relevant data and ensure high DQ. After ensuring high DQ, we have to decide what type analytics we need to use based on Table 2. Based on the data and the constraints we have, we can build suitable frameworks/models. In the next step, we need to validate the frameworks/models by including data that was not part of model building activity. After validation step, we should have a plan to deploy these insights in decision-making

Fig. 4 Process of executing analytics



activities. Note that we need to standardize the method of deploying the insights as much as possible.

In Fig. 4, “ensure high quality data” step is highlighted because high-quality data is absolutely required to run sound analytics and get meaningful business outcomes. Often analytics fail because of poor-quality data and the loss associated with poor-quality data can be quite significant. A combination of high-quality data and reliable analytics will result in increased levels of customer, regulatory, and shareholder confidence by minimizing societal loss with maximum profits.

Conclusions

The conclusions of this chapter can be summarized as follows:

- Data and analytics capability management aspects have become critical functions in managing overall business and achieve business excellence. They should be viewed in the same way as other resources such as people, facilities, raw materials etc.
- For running high-quality data analytics, it is extremely important to have high-quality data. Therefore, preparatory analytics and cross-examination of data play a significant role.
- Different types of analytics exist and we should choose suitable type depending on the purpose and business requirements.
- Good data coupled with sound analytical techniques are key for organizational success because they provide very important insights and that will help in making sound decisions.

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Author Biography



Author's Short Bio and Perspectives

Name: Rajesh Jugulum

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Education: Ph. D

Current Job: Director of global data strategies at Cigna
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Previous Jobs: held executive positions in quality related areas
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Introduction to Quality: I was introduced to quality field during
my Masters Degree at Indian Statistical Institute.

Favorite Definition of Quality: Quality must be measured in
relation to loss imparted to society (Dr. Taguchi's definition).

Major Contributions to the Field: In multivariate analysis
using principles of quality engineering and in the area of
data/information quality.

One Trend Defining the Future of Quality: Data and information quality

Impact of Feigenbaum Medal: It gave me lot of recognition.

Favorite Book on Quality: Introduction to Quality Engineering: Designing Quality Into Products
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Three Publications:

1. Genichi Taguchi and Rajesh Jugulum (2002) The Mahalanobis-Taguchi Strategy: A Pattern Technology, John Wiley & sons.
2. R. Jugulum, D. D. Frey. Toward a Taxonomy of Concept Designs for Improved Robustness. Journal of Engineering Design, Vol 18(2), 139–156, 2007.
3. Jugulum, Rajesh (2014). Competing with High Quality Data: Concepts, Tools and Techniques for Building a Successful Approach to Data Quality, Wiley publication.

Plans for the Future: Continue to contribute my part to quality field.

Quality Quote: Data quality and information quality are as important as quality of
any product or service and they will be key aspects of big data world.

The Future of Quality: Strategy, Leadership and an Opportunity to Improve Quality of Life on a Global Scale There to Be Seized or Lost

Denis Leonard

Passion is found in leadership that recognizes the pursuit of excellence is the most powerful emotional motivator in any organization. Passionate leaders have a bias for action in implementing this ethic throughout the organization

Feigenbaum and Feigenbaum (2003, p. 45).

Introduction

Quality management has evolved to a point of exciting opportunities; it has made dramatic impacts and has yet to fulfill its potential. The future of quality management as we move forward in the twenty-first century has obviously three paths to follow. One of continuing to change and evolve, one of status quo that is having the same level of impact as it currently has or finally, devolving that is stagnating and being subsumed into other disciplines, being weaker for that and fading away. We need passionate leaders in quality to seize the opportunity, to ensure the path we take is the one of continuing, and to evolve and strive toward quality fulfilling its promise.

The Danger: Fading Away

In the early 2000s I was asked to meet with a VP (who had a PhD incidentally) who asked, so you have PhD in Quality Management, can you do that, I mean wasn't Quality a thing in the 1980s is it still around. For many that is exactly the case, quality is a thing of the past it was a fad and fads are corrosive. Now for those of us working in quality it is hard to believe that such a view exists, however, for many quality management does not exist anymore! There is a limited awareness of

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quality, consider how many quality management courses are taught at Universities. They are correct in that in many cases; quality management has become a sub-section of operations or even production specifically quality control, i.e., inspection. For many even a customer relations department has nothing to do with quality. It is as though quality management has become fragmented and been absorbed into other departments, but not in the ‘Quality will become everyone’s job’ way! The irony is that being absorbed into other departments it has lost its connectedness and its systems approach. So, now even if we can pick apart quality within an organization the connections are not there, those connections that allowed quality to leverage its ultimate manifestation, its strategic role and impact. Part of the reason for this fading, fragmentation, and absorption has been the distraction of viewing quality as a set of tools, and operational tools at that, which can be used individually indeed not even individually but as separate standalone tools with a lack of awareness of the existence of other tools and their wider context.

The focus on selling a silver bullet has been a significant driver of this view, whether it is Six Sigma or Lean for example. Of course if seen within the larger context of quality management, Six Sigma and Lean are fine. As Feigenbaum said “properly done, they are all part of the constant evolution of quality and the opportunity available to quality professionals—the opportunity to reach forward. This is not a field where you are condemned to do something forever just because that’s how it’s always been done” (Kubiak and Feigenbaum 2005, p. 58).

But so often they are sold as standalone methodologies, becoming whole disciplines in and of themselves. For example, papers are written about the evolving nature of Six Sigma or Lean to add such elements as leadership or culture to help sustain them, because shock, without building a base of culture, knowledge, strong leadership and initiatives directly aligned with strategic goals Six Sigma and Lean cannot attain their full potential or be sustained. These are discussed as though all the previous work on quality management by Deming, Juran, Feigenbaum, and others never existed.

By agreeing with this the whole bodies of knowledge are ignored and at ones peril. For example by focusing only on Six Sigma or Lean as operational tools only and ignoring the fundamentals of quality management, there is no philosophical core, that is such teachings as a customer focus, valuing employees, Deming’s deadly disease of an emphasis on short term profits or the use of systems theory and strategic focus are not considered. Therefore, Six Sigma and Lean become project orientated, initiatives, by definition fragmented with the danger of not being strategically aligned, addressing waste and cost cutting without considering the employee nor indeed the customer, the fundamentals of quality.

The danger is that when Six Sigma and/or Lean are seen as being ‘Quality Management’ in and of themselves, and this is believed, they fail, therefore quality management is seen as failing, while in reality they only constitute elements of quality management and failed because they were only the implementation of a few elements of quality management. The urban myth of the poor success rate of quality implementation persists despite the similar failure rate of project management launches, company mergers, and especially IT initiatives.

Six Sigma and Lean have been widely embraced and have indeed supplanted quality management helping to in the minds of many, reinforced the fact that quality management is a thing of the past, thereby ensuring it becomes just that! The other danger is that while quality management is being replaced by Six Sigma and Lean as the new quality reality, they are themselves being replaced and in a way undermined with Lean Six Sigma. The question is what is next. If Six Sigma and Lean are really not the silver bullet and Lean Six Sigma is, then it is only a matter of time before another silver bullet, fad, comes along to supplant them, and what knowledge will be jettisoned to drive it? This has been the trend and such money spinning trends will always continue to exist, but the extent to which is the real issue.

Another sign of the potential fading of quality is the changing profile of organizations. This includes outsourcing and the issue of minimum wage. These are philosophical and strategic issues of course, the lack of which as argued above weakens quality management.

The voice of quality management was not heard in its examination of outsourcing. While in the 1990s, with labor costs in China so low the temptation was too much, and so western manufacturing was shifted to China and later other countries. Of course as time went on entire supply chains were moved overseas to the point that the infrastructure even skills required no longer existed in the USA. This worked in the short term, but what was the impact, the loss. The customers who were to purchase these products were losing their jobs or taking lower paid jobs and were moving wherever jobs could be found creating huge impacts on communities and society. We would reap what we would sow. When China's and India's labor costs began to rise dramatically not to mention fuel prices, and difficulties such as a lack of flexibility, i.e., with material mid-Pacific transport time created a downside, the short term savings began to erode. This has resulted in a reduction in outsourcing. It is not over, nor will it be as long as cheaper is better, but precision manufacturing is now being kept rather than outsourced. Of course this means that the skill levels have increased and specific and high level training is required with a focus on manufacturing technology, can we achieve this?

So the decision to outsource and now the decision to reverse to some degree have occurred without the influence of quality, that was a loss and highlights the value and important voice that quality could have provided and still can, but leadership is needed to raise that voice. The issue of minimum wage is certainly still here, do we have an opinion and a voice regarding it? Both outsourcing and minimum wage center around the old axiom, 'our most important assets are our employees' they are a fundamental for quality yet are either of these following the teachings of Deming. To "end the practice of awarding business on the basis of price tag" (Deming 1986, p. 23) or not making people "commodities" (Deming 1986, p. 77). Deming stated that it is not responsible to dump employees on the heap of unemployment that management must declare a policy for the future, to provide jobs for their people, and more jobs (Deming 1986).

During the Great Recession and the economic instability that currently exists, quality had and has a huge opportunity to provide leadership and solutions;

however, there was no quality revolution, no rush to embrace quality management. That was and is a lost opportunity. But there is still time to recover, but will we? The answer is we need to seize the opportunity that still exists.

Our Current Status: Do We Continue the Status Quo?

If we do continue on at our current status quo where exactly is that?

The ASQ Global State of Quality Research, Discoveries 2013 by ASQ APQC provides excellent insights with over 2000 respondents from over 22 countries.

This report showed that only 24 % saw quality as a method to manage organizational wide performance, rather it was seen as a “tool to fix issues after being discovered” or a “continuous improvement activity” or a “compliance activity” (ASQ and APQC 2013, p. 14). In other words as a tactical at best but mainly operational issue.

This is supported by another question posed regarding who governs quality, that is, who sets policy, strategy, and quality goal. In 50 % of companies below \$100 M revenues it was by Senior Executive Leaders/Officers, however, as revenues increase this C level influence of quality falls to 18 % \$100M-1B, 13 % \$1B-5B, 3 % \$5-10B 3 % and 9 % > \$10B 9 % (ASQ and APQC 2013, p. 13).

In other words quality is not a strategic or C level issue. Regardless of the strategic nature of quality, when we look at how it is used we find answers like:

“Our belief that the customer is the only person qualified to specify what quality means, from disagree to agree only 13 % agreed. Our Organization seeks to understand product performance through the customers eyes, 46 % agreed” (ASQ and APQC 2013, p. 27). The customer does not have the dominant focus that it should, or is so often touted, it is not driven by the customer, that which should be at the core. If not strategic and not customer driven Quality is as I argued earlier viewed primarily as an operational cost reduction compliance tool. In other words quality is still seen as part of the problem not the solution.

While the best, the pacesetter “corporate leaders have come to emphasize that—in global terms—quality is not only a technical subject, but also a fundamental way to manage and lead organizations. In other words, quality has become the basis for systematically guiding, empowering and supporting the constant pursuit of product and service quality excellence. It is also the basis of strong and continuous innovation in design and engineering, supply, production, sales and other related processes throughout an organization” (Feigenbaum 2009, p. 20). They are just that pacesetters, showing how quality should and can be implemented, but this is far from the norm.

Many organizations still function as though they are in the 1930s or 1950s, with workers ‘punching in’ every morning and given a carefully allocated number of minutes of restroom breaks per shift. Is this the employee empowered organizations that we hear so much about as though they again are the norm? Deming said “we are in a new economic age. Western management must awaken to the challenge”

and “drive out fear” (Deming 1986, p. 23). Have we awoken, are we in such a new economic age, have we driven out fear, when one sees such practices one wonders? And this is in the US economy this is not talking about where we outsource consider the 2010 Bangladesh clothing factory where a fire killed 112 people because there was no fire exit (Yahoo News 2012) or Foxconn the Chinese manufacturer of the iPhone and other blue chip company products, which had suicides at its plant that raised alarms by watch groups in 2010 through 2013 (Business Week 2010, 2013).

During the Great Recession, there was not a realization of what quality could provide rather it was a focus on head count reduction and leveraging the remaining employees. Or as Deming called it “beat horses and they will run faster—for a while” (Deming 1986, p. 22). Downsizing has become a normal part of business and yet the reality of it seems to fall on deaf ears, how clearly are we, in quality speaking about this.

A study of 442 companies that applied for *Fortune* magazine’s “100 Best Companies to Work For in America,” showed that a planned downsizing of 0.5 % results in a post-downsizing turnover rate of 13 % and a downsizing of 2 % creates a turnover rate of 14.1 % (Trevor and Nyberg 2008).

Unfortunately, the post-downsizing employees who leave on their own accord are the higher performers who the organization wanted to keep. Other consequences include a reduction in productivity and negligible improvement in long-term profitability (Palliam and Shalhoub 2002). Indeed, large downsizing “only rarely achieves its original financial objectives” (Makawatsakul and Kleiner 2003). “Only 41 % of organizations that conducted downsizing found productivity increases, and only 37 % have realized any long-term gains in shareholder value” (Reynolds Fisher and White 2000).

The reasons for this relate to a multitude of other unintended or overlooked impacts, such as conducting a simple headcount reduction without consideration of customer, production, quality, or knowledge management requirements. Also, funds to drive improvement or to change production methods may not be available because they were expended on the downsizing. What funding is available usually is needed for retraining and rehiring at a later date.

Creativity and innovation decline significantly during downsizing and increase only modestly afterward (Amabile and Conti 1999; Williams 2004). Additionally, employee involvement can be affected dramatically. Among the other negative results are decreased morale, fewer employees participating in teams and initiatives, and a decline in the quality and quantity of employee involvement activities (Buch 1992; Lee and Corbett 2006).

Also, up to 50 % of those who survive downsizing report job stress and symptoms of burnout and have their trust in the organization destroyed (Mishra and Spreitzer 1998).

The issues of outsourcing and downsizing are just a few of the issues to which quality can contribute. Consider the BP Gulf oil spill or the Japanese tsunami and its impact on the international supply chain. The Enron, WorldCom, the financial crisis that led to the Great Recession, national food issues involving *E. coli*, horsemeat in

the beef supply, international toy recalls due to hazardous levels of cadmium, IT security and Homeland Security. The global environment has not become slower or safer, quality is needed yet we have not reached a Strategic Quality Plateau that is sometimes assumed. Big Q has yet to be achieved, but it can be.

Our Opportunity for an Evolving Quality Management

The future of quality lies in invigorating the quality movement, ensuring that we seize the opportunity that lies before use and avoid quality fading, moving on from our current state, and driving quality forward to continue to change and evolve.

This means clearly articulating and educating on the full strategic role and impact that quality management provides its aligned strategic, tactical, and operational abilities. Indeed the national economic and industry level perspectives, values, and solutions it can impart. This includes voicing the facts of the negative economic impacts of such issues as downsizing, outsourcing, and not raising minimum wage and the positive economic impact of quality to the point that its value is appreciated by financial institutions. If Wall Street understood the financial impact and sustainability of quality, then the role of quality would be changed forever. Why not have an ultimate stretch goal! As Feigenbaum said we must be able to prove and explain the economics of quality (Feigenbaum and Feigenbaum 2003, p. 61). How often do we still get asked if quality has a ROI!

The imperatives for the future of quality management include

1. Driving strategic quality at both corporate, industry, and national levels
2. Defining and promoting leadership principles founded on the principles of quality
3. A focus on quality culture its values and principles
4. Reviving systems approaches to strengthen integrated management systems and interdisciplinary functioning
5. Leveraging quality culture, principles and tools to help achieve and provide a leadership role in social responsibility.

Each of these imperatives consists of critical elements needed to change and further evolves quality management.

Driving Strategic Quality at Both Corporate, Industry and National Levels

Quality at this point in its evolution, in the pacesetter (as Feigenbaum calls them) organizations is no longer an independent function, it is not about tunnel vision, a focus only on the reduction of variation on the production floor, it is no longer just

about the product but the management of all operations and should be integrated into all aspects of the business. Focusing on every aspect of a business requires a systematic look at an organization to discover how each part relates to the other. Quality is a company-wide issue; it should be seen as part of the corporate strategy not simply a separate tool but interwoven into the very framework of the strategic process.

It will only be effective to the extent that it permeates the entire organization and only if it is disseminated and accepted effectively especially by senior management. If senior managers do not consider quality an integral part of corporate strategy, then it will not be truly integrated it will simply be a bolt on and never achieve its full potential. A pervasive quality strategy provides the basis upon which plans are developed and communication is achieved.

If quality is not linked to the strategy of the organization in other words to the central business issues it will ultimately fail. In many cases, quality is implemented in this way and methods and tools are continued in isolation, when the focus lingers on the implementation of individual improvement initiatives, the importance of the strategic aspect is lost.

But such implementation needs to be expanded beyond the pacesetters.

Defining and Promoting Leadership Principles Founded on the Principles of Quality and a Focus on Quality Culture Its Values and Principles

Quality leadership is where quality principles become “a basis for guiding, empowering and supporting the constant pursuit of excellence by the employees throughout the organization” (Feigenbaum 2007, p. 38). In this regard, the emphasis is on “creating the power of an environment of trust, openness and honest communication to encourage the development of individual quality improvement entrepreneurs” (Feigenbaum 2007, p. 39). The leader specifically “has the responsibility to improve the system, i.e. to make it possible, on a continuing basis, for everyone to do a better job with greater satisfaction” (Deming 1986, p. 248). This leader “instead of being a judge, will be a colleague, counselling and leading his people on a day to day basis, learning from them and with them” (Deming 1986, p. 117). While these are the principles upon which quality leadership is built, how it is applied means that it is “necessary to apply the entire array of quality know how (the quality disciplines) throughout the entire company to all functions and all levels and to do so in a coordinated way” (Juran et al. 1995, p. 128).

Quality Leadership will establish and drive quality culture. Such examples need to be shared; their impacts highlighted and held up as the exemplars of leadership.

A leadership approach that has a natural affinity to quality management is servant leadership which emphasizes an increased service to others, a holistic approach, promoting a sense of community and the sharing of power in decision-making. It is a practical philosophy concerned with the ethical use of power and authority. Such leaders see power and authority as ways of helping and inspiring others to grow, not for exploiting, ruling, or taking advantage. At its core, servant leadership is a long-term approach to life and work, which has the potential for creating positive change throughout society with a focus on ethical behavior and a concern for subordinates (Greenleaf 1977; Greenleaf and Spears 2002; Ndoria 2004; Ehrhart 2004). At its core, servant leadership is a long-term, transformational approach to life and work that has the potential for creating positive change throughout our society.

The establishment and acceptance of quality leadership and culture as one of achievement and success, would help sustain quality during succession. So often successful leaders having leveraged quality management in its best ideals, and having the results to prove it are replaced by leaders who ignore the results and sweep away quality setting the organization back years. In some cases, this is a matter of ego and wanting to wipe the slate clean providing a chance to show how much better they are than their predecessor, but in others it is an issue of not believing in quality, as though it was an issue of faith alone, and ignoring the facts. If doing so would be seen as going against common sense business practices, a disregard for the good of the company, reacted upon with a drop in share prices for example, then such Leaders would not consider such sweeping away of quality and we will have truly achieved a strong future for quality.

Reviving Systems Approaches to Strengthen Integrated Management Systems and Interdisciplinary Functioning

The Baldrige Criteria for Performance Excellence and the EFQM Excellence Model and those criteria and models around the world that have used them as inspiration provide key vehicles in driving and achieving systems integration and an interdisciplinary focus. We need to create opportunities to use these models and criteria. While nations such as India embrace them the originator countries seem to be unaware or unwilling to engage in the opportunities they provide.

The Baldrige criteria developed by the National Institute for Science and Technology (NIST) is a nonprescriptive model for driving business excellence throughout an organization whether it is manufacturing, service, nonprofit, education, healthcare, or a small business. The criteria strive to promote a systems approach to organizations. It becomes an umbrella under which various initiatives;

standards and programs can be strategically coordinated for the monitoring, measurement, and implementation of continuous improvement.

The Baldrige systems based approach highlights:

- The importance of leadership
- Need to consider all elements of an organization
- Strategic importance of scanning and analyzing the business environment
- Value of creating focus on customers and employees
- Need to use measures, indicators, and organizational knowledge to identify and monitor key performance indicators
- Methods for approach and deployment of improvement action plans

The Baldrige criterion enables organizations to adopt a more strategic perspective. The benefits from this strategic approach are

- Driving cross-functional involvement
- Coordination of strategic and operational improvement efforts
- Measuring and monitoring progress
- Conducting organizational wide assessments with feedback and a support system to create prioritized areas for improvement

This is what gives Baldrige its coordinating and aligning nature; it is also what gives Baldrige its wide appeal and adaptability. Its focus is on the basics or essentials for excellence, which is why it has been implemented internationally and in many cases used as the basis for other national quality awards. The common theme with each national quality award criteria is their inclusive nature, for example the criteria do not specify what tools or techniques should be used or in which circumstance allowing flexibility. Rather the criteria are the strategic coordinating methods used to drive improvement and integrate the various tools and techniques required to achieve the corporate strategic goals. The criteria also provide an effective way of conducting company-wide, cross-functional self-assessments. The tools and techniques used to achieve the opportunities for improvement (O.F.I.'s) uncovered by self-assessment or feedback from an award application depend on how far along the quality journey the organization is, their current needs, experience, skill set, and culture. In this way Baldrige can make sense of a whole range of tools, techniques, and initiatives, which, without alignment become an uncoordinated and ineffective group of activities. The Baldrige criteria states that "integration builds on alignment, so that the individual components of your performance management system operate in a fully interconnected manner".

Such models as Baldrige and EFQM also provide an excellence infrastructure under which to coordinate and support integrated ISO management systems. These ISO Management Systems can support us in dealing with our fast moving environment are the worlds' most referred and implemented standards of quality,

safety, environmental, social responsibility, and risk Management. Combined they provide an infrastructure to manage the range of diverse variables such as those mentioned above while supporting strategic decision-making and sustainability. At the core of this set of Management and Leadership Standards is ISO9001 (Quality Management System Requirements) critical to their integration and ISO26000 and most recently ISO31000 (Risk Management: Principles and Guidelines) which, while a new standard is one that has the potential to have the largest impact in the future.

Quality management has a significant impact on the most commonly used management standards through the PDCA operating principle of ISO's management system standards and because the other management standards such as ISO14001 and OHSAS18001 are based on the ISO9001 framework for direct alignment. Due to this influence, ISO9001 is a key driver and coordinator of other standards including ISO31000 and thereby facilitates the leverage of integrated management systems, in and of itself a driver of efficiencies. The trend for these management systems is to continue to align and afford integration.

Leveraging Quality Culture, Principles and Tools to Help Achieve and Provide a Leadership Role in Social Responsibility

“From a business point of view, environmental issues and quality issues are coterminous” (Kubiak and Feigenbaum 2005, p. 61).

Social responsibility and quality management are strongly linked through such principles as ethics and respect for people. Indeed quality management provides tools, techniques, and management systems ready to implement and achieve SR goals and make our world a better place.

Some key examples of these principles linking SR and quality include the philosophies of Philip Crosby, W. Edwards Deming, Joseph M. Juran, and Kaoru Ishikawa. Crosby talked of integrity, saying The Chief Executive Officer is dedicated to having the customer receive what was promised, believes that the company will prosper only when all employees feel the same way and is determined that neither customers nor employees will be hassled (Crosby 1986).

Deming's 14 points highlighted the “driving out of fear” to release the ability to ask questions and express ideas, break down barriers between staff, encourage pride in workmanship, and establish self-improvement for everyone. Deming supported an organizational climate where dealings between managers, employees, and customers were conducted on an ethical basis (Deming 1986). Based on Deming's teachings, the organizational structure—and, importantly, the reward and recognition system—must promote organizational values and not create contradictions. This results in a culture of trust and openness both inside and outside the organization, ultimately improving corporate reputation.

Juran spoke of a system of values, beliefs, and behaviors that are necessary for organizational success. He espoused the view that quality is recognized for its focus on people through work life and employee satisfaction (Juran and Gryna 1993).

Ishikawa made a particularly strong statement on behalf of SR when he said, “The first concern of a company is the happiness of the people connected to it. If the people do not feel happy, ... that company does not deserve to exist” (Ishikawa 1985).

The Quality Scenario

If quality management was recognized and embraced to its ideals, its impact on economies and society would be dramatic.

As software capabilities continue to dramatically develop, we have the ultimate goal of creating expert systems that provide a support infrastructure for integrated management systems aligning strategic, tactical, and operational levels of an organization, with linked quality tools, self-assessment, diagnostic, and measurement abilities driving cost of quality and root cause analysis at a real time level. This would also link to global benchmarking across industrial sectors allowing best in class and world class metrics to be easily compared to. This would ease the ability for individuals and organizations to access and build quality Systems.

If the quality focus on long-term financial sustainability was used rather than the current short term financial focus, we would have more stable financial markets. Fluctuations in the market would ease and economic cycles of boom and bust would not be as dramatic, lowering the impact of recessions and significantly reducing the role of downsizing. Fair wages and working conditions could be the norm in every country.

With cost of quality used as a part of normal business practices, internal and external failure costs would be significantly reduced. This would result in a major drop in hospital death rates, workplace accidents and deaths, material waste, insurance costs and ultimately cost savings to both industries and governments at national, regional and local levels.

The improvement in healthcare and education and the reduction in healthcare costs would raise standards of living.

With SR leveraging quality, the negative impact on the environment would be reduced and impacts ranging from smog reduction to a revitalization of oceans would improve the health of millions for example by reducing the cases of asthma and through reduced mercury levels in seafood while sustaining our environment for the future.

Employee satisfaction would increase along with productivity and customer satisfaction. Employee stress and other related issues would be significantly reduced resulting in reduced absenteeism and low levels of employee turnover.

All of the above would result in a higher standard of living globally.

Conclusion

The irony is that those who have embraced quality management in its fullest form have seen dramatic impacts in their organizations be it in service, manufacturing, or nonprofits, not to mention those ever present difficult areas of national importance education and healthcare. The solutions are there and they are held by quality management yet only experienced by a relative few. Our future is to broaden the impact and improve the quality of life on a global scale. The key is the strategic application of quality!

There are significant opportunities for the future of quality management and they are not years away but upon us, but they need to be taken, we have the chance to seize, control, and drive quality or see it squandered. Quality has evolved and expanded and its future is to continue this trend.

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Author Biography



Denis Leonard has a degree in construction engineering, an MBA, a PhD in Quality Management, and a Post Graduate Certificate in Teaching and Learning in Higher Education. He is a Fellow of the Chartered Quality Institute (UK) and Fellow of the American Society for Quality with whom he is a Certified Manager of Quality/Organizational Excellence, Auditor, and Six Sigma Black Belt. As an ASQ Feigenbaum Medallist, he was a Visiting Assistant Professor in Quality Management at the University of Wisconsin–Madison, and has won several international awards for research publications. He has served on The Baldrige National Quality Award, Wisconsin Forward Award, National Housing Quality Award, Northern Ireland Quality Award, and the International Team Excellence Competition. He is a member of several boards including the U.S. (ANSI) Standards Group for Quality Management, ASQ's Quality

Management Forum, and the ASQ Quality Management Divisions, Organizational Excellence Technical Committee. He has experience in management, engineering, training, auditing, and consulting, with expertise in strategic and operational quality improvement. He has won his clients national awards in quality, safety, and environmental management. He has coauthored *The Executive Guide to Understanding and Implementing the Baldrige Criteria*. He is the President of Business Excellence Consulting and lives in Bozeman, Montana.

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Current Job: President of Business Excellence Consulting

Previous Jobs: Quality Improvement Manager, Veridian HomesQuality Systems Manager, Rayovac CorporationVisiting Assistant Professor, University of Wisconsin—Madison

Introduction to Quality:

My introduction to quality was through the classes taught by Dr Joe Gunning when I was studying for my engineering degree. He articulated the impact of quality and its potential and it became a passion.

Favorite Definition of Quality:

'Create constancy of purpose toward improvement of product and service, with the aim to be competitive, stay in business and provide jobs.' Deming

Major Contributions to the Field:

The development of the 'Quality Life Cycle' which has been cited in the respected quality textbook 'Managing for Quality and Performance Excellence' by Evans and Lindsay.

My role in the growth and development of the Baldrige based US National Housing Quality Award including the creation of its 'NHQA House of Quality Model'.

Work on the role of quality management in supporting and driving corporate social responsibility. My work was quoted and my 'Quality Management Environment' model was used by the

ASQ in its launch of its social responsibility focus in its ASQ/BSR Executive Brief, ‘CSR and Quality: A Powerful and Untapped Connection.’

One Word Defining the Future of Quality:

Strategic

One Trend Defining the Future of Quality:

Driving strategic quality at corporate, industry, and national levels. This includes/incorporates a focus on leadership, culture, social responsibility, and sustainability in every sense.

Impact of Feigenbaum Medal:

Being presented with the Feigenbaum Medal by Dr Feigenbaum himself and having the chance to talk with him had a major impact on my life. His intellect, impact on the profession, philanthropy, and modesty provide a wealth of ongoing reflection and learning.

Favorite Book on Quality:

Out of the Crisis, Deming

Three Publications:

Leonard, D (2013) The Efficiency Impact of International Standards on Global Trade, National Industries and Individual Organizations: The Influence of Quality and Risk Management, Standards Engineering: The Journal of the Standards Engineering Society, January/February, Vol 65, No 1, pp 1–8

Leonard, D, & McGuire, M (2007) The Executive Guide to Understanding & Implementing The Baldrige Criteria: Improve Revenue and Create Organizational Excellence, *ASQ Quality Press*.

Leonard, D & McAdam, R (2003) “Quality’s Six Life Cycle Stages”, *Quality Progress*, August, Vol. 36, No 8, pp. 50–55.

Plans for the Future:

To continue to drive and impact quality in the US residential construction industry through the Baldrige based National Housing Quality Award (NHQA) and to support the ASQ, QMDs, Organizational Excellence Technical Committee (OETC) as a founding member.

The OETC goals are to be a reference point on excellence frameworks and models (including EFQM & Baldrige) to contribute to a body of knowledge on excellence models; promote the use of international, national, and local excellence programs; share case studies, lessons learnt, success stories about performance, make assessments tools available; and how quality methods and tools integrate with excellence models.

Quality Quote:

“Quality is a duality of philosophy and technique, a set of principles and foundational approaches with a range of problem solving tools and techniques that can impact every aspect of our lives.” Denis Leonard

Common Sense, Use the Right Tool for the Job

Barbara J. Santiano

Refreshing Views Over Quality—Quality in the twenty-first Century.

The beauty of the field of quality is that the concepts, theory and tools are sound and have all been well proven over time. While “quality” in and of itself is basically the same, each company can take the quality concepts and principles and create a quality system that is as unique as they are. Every company implements quality differently making no two quality systems the same.

The quality concepts can be applied to any industry including government. Even government agencies implement quality programs and they started with the basics: identifying customers. An eye opening experience for some to realize that they had the largest customer base of anyone: any company, any organization. One lieutenant who did not think he had any customers was taken aback when it was pointed out that everyone in the entire country (and possibly the world) was his customer.

The senior leadership of one small privately held company basically believed in the principle, I will do what I want with my company. I really do not blame them. If I ran my own company, I would probably do and feel the exact same way. No one would tell me what I could and could not do or what I should or should not do. Well, in this case, quality was no different. Customers started requiring ISO 9000 (ISO) certification. This did not sit well with a lot of folks. Maybe it was because someone else was dictating what they needed to do, maybe it was because it was not their idea or maybe because it was just perceived as a way to spend money on something they did not need or want. Reluctantly, the company started on its quest for ISO certification. Now, depending on who you were in the company, this was either good or bad news.

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Some departments saw the advantages to ISO compliance right away. Manufacturing for one was thrilled with the ISO program because it provided evidence that there were processes and controls in place and this made customers very happy. Implementing ISO meant customer surveys were shorter, less frequent, and there were less customer visits. The ISO framework also provided repeatable processes that could be followed by everyone in manufacturing. Everyone knew what was needed to be done because it was clearly defined.

Some departments (engineering for one) were less than thrilled and those were the folks who thought ISO was telling them what to do and how to do it. These folks never fully embraced the benefits the ISO structure could bring them. But rather it was seen as a hindrance to their creativity and design process. It was also seen as a distraction and an added step in the process. Engineers are supposed to design, not write documents was a common sentiment. Well, that is partially true. There is a value in documenting what you are doing, capturing requirements, and validation activities. And in a lot of cases they did what was required, they just did not want to put it in writing and have someone hold them accountable. Furthermore, engineers wanted to do things on their own schedule and not when the procedure told them it was time to release a document or hold a review even though they wrote the procedure and thought it was a good idea at the time.

The most interesting twist was that they had two engineering offices and they were complete opposites. One saw the benefits of the ISO program and having documented procedures and wanted to follow them. The other office wanted no part of it. Eventually, they all learned it was problematic if they could not figure out who was doing what because they did not have meeting minutes, design review notes, detailed specifications and test plans. It became difficult for one office to work with the other.

To some degree the level of difficulty in implementing a quality program stems from the individual's background and prior experience with a quality system. And those experiences and mind sets are hard to change. Once someone has decided there is no value in a quality system and there is a way to avoid audits or figure out the right thing to say to the auditor, getting them to change their mind can be quite the challenge. And there goes any chance of gaining any valuable audit results. The attitude disseminates to those around that person like a cold virus and once it starts, it is very hard to remedy.

People would find ways around the system and ways to avoid following the procedures that were in place. This led to internal audit findings, corrective actions, and root cause analysis that led to angry people. This was because people did not have a say into how the quality system was created but rather a quality system was forced upon them.

Rather than create a procedure around what tasks people were actually doing, the procedure was written to be compliant with ISO and the way someone wanted the process to work. Nothing will set you up for failure faster than taking this approach to implementing quality and an ISO program. As a result, no one liked the process so they did not follow it. In order to fix the issues, the procedure had to be rewritten to actual practice to meet the needs of the people involved. Of course it has to meet

the requirements of the standard, but it is not impossible to incorporate the requirements into any existing process. More importantly, if the concept of the requirement was discussed, chances are the person would agree to do the task without having to say, ISO says you have to do it. No one likes being told what to do and following the ISO standard was no exception. In general, the concepts ISO required were agreeable to the employees. And presenting the requirement as an idea, such as documenting design or product requirements, made the ISO requirement seem reasonable and agreeable. Presenting the concepts in a way that allowed people to define how they would execute the requirement made a world of difference. Now the company was doing what they wanted to and not something because ISO said they had to.

ISO is just a framework, a foundation. You build the rest of the house. Meaning, while ISO does have some items you have to have and certain requirements you must to do, you decide how you will do them. If ISO is the foundation of your house, you still build the walls, select colors and decorate. It is like a bowl of vanilla ice cream. You add the topping you like to make it yours. If you gave 10 people a bowl of ice cream and a topping bar, everyone would have a different sundae. The same is true for ISO. No two quality systems are ever the same because they are customized to fit the needs of the business. The purpose is to take the framework and make it yours. Do what you want, the way you want to do it.

All too often I heard from people, we do it this way because ISO says so. When I hear this I know that someone did not take the time to truly understand the ISO concept or to interpret what that concept meant for their business.

Once the framework is in place, you can begin to customize and change the procedures so they work for you. I was always amazed at the responses I would receive when I would tell people that they could change a process, form, or document. It took a while but slowly the quality system was rebuilt in a way that made it unique and valuable to the company. That is how you make the most of your ISO program.

I have seen a lot of companies put processes in place that did not work for them. They created a system that was not customized or created for the specific company but rather what someone else recommended or thought it should look like. I recall one company of less than ten employees that had created an internal audit schedule that called for audits to be conducted weekly. It was impossible for the limited staff to be compliant to such a burdensome audit schedule. It was by far the most complicated audit schedule I had ever seen. When asked why they set up such a complicated program they said, their consultant recommended it. The program not only set them up for failure and external audit findings but it was not appropriate to their business structure and therefore was not adding any value to the company.

But ISO is not the only quality concept you can implement. ISO is a tool, one of many that should be in your quality toolbox.

One should view “quality” as a system which is made up of different tools that work for you. You can use the ISO guideline as a tool because there is value in having processes defined and documented. It is critical to know what you do and how you do it. It is useful for multiple people performing the same job and it is

necessary to ensure consistency and repeatability. But it is not the only tool nor should it be and you can use as many tools as you like that are appropriate for the job.

Another useful tool you must have in your toolbox is some sort of continuous improvement activity. There is a lot of value in looking at your processes and constantly looking for better (be it faster, cheaper, more efficient, or more effective) ways to improve. And I do not just mean cheaper to be cheap but rather more cost effective and better use of resources. Everyone's time is limited and making the best use of that time is what can really make a difference in getting product out the door and having employees satisfied with themselves and their job.

A continuous improvement program can take on a life of its own. A good continuous improvement program is whatever helps you look at your processes, review them, and find a new more effective way to get the job done. Continuous improvement programs can come in many forms. They can be lean programs, six sigma programs, a combined lean-six sigma program, 8D, 5S, and so on.

Personally, I prefer the "just do it" approach. If you have identified a new way to do something, just do it. Fix it, change it, and just make it happen. There is nothing wrong with a formal six sigma program but one must be careful that the program they create does not become so overly burdensome with tracking requirements that people do not use it. For example, a company that uses a specific six sigma project tracking tool might find that once they start using the program the tasks of entering the information becomes time consuming and requires more detail than the project took to implement. It should not take just as long or longer to get a project through the tracking tool as it did to complete the improvement activity. The tools you choose to help your business should not slow you down. If the tool is slow, complicated and not user friendly, people will not use it. When this happens, folks start discussing the usefulness of the program (or the lack thereof), stop entering projects which results in the loss of being able to track project savings. In the end a company that spent a lot of money to purchase and maintain a tool is not being used. As a result, new tools can be discussed and researched, tools that better fit the goals of the company.

If a commercial tool does not exist, create one. There is nothing that says you cannot create your own database or spreadsheet to track projects. Do what makes sense for your business and your quality program goals. Choosing the tool that is right for the job is also important. If you are a small company, use a tool you can easily manage and afford. Of course, just because you are a larger company does not mean your program has to be huge and overbearing; you might just need more capability or storage, not necessarily more complexity.

You also do not have to use every tool all the time. Like a builder with a new tool box, you do not have to use all the tools for every project all the time. You should pick and choose the correct quality tool for the job. And you should never use all the tools just because you have them. Just because you know how to do 8D does not mean it is always the right tool to use. If you do not need a fishbone diagram, do not make one. Find the right tool to solve the problem you have.

Programs that combine tools can be problematic for that reason. For example, a company that combines the concepts of lean and six sigma into one program called lean-six sigma. The problem was that sometimes you need a lean tool to improve a process and sometimes you need the statistical tools a six sigma program provides to resolve an out of control process. There are certain circumstances where a problem can be improved by lean tools and then adding a six sigma tool, or the other way around, but not all the time. And here lies the downfall of this program. Because in a lean-six sigma program, you have to use both lean tools and six sigma tools, even if the tools did not apply. It is like fitting a square peg into a round hole. You force fit a tool to show you know how to use it, even if it is not the right tool to use. It is possible to have a lean project that does not have or need statistical data, run charts, and control charts. There is nothing wrong with this and it is absolutely fine. It does not make it less of a project or less important and it could save just as much money as a project that does lend itself to a run chart and histogram and other statistical tools. It is possible to work in the quality field and not use a control chart. You can still improve many processes and saved thousands of dollars. It all depends on what you are measuring, tracking, and improving.

One clever trick that can be successful is by not telling people they were involved in a lean project. Simply facilitate the project and improve the process without all the “quality talk”. Again, just do it. No one needs to know it was a lean project and the name of the tools being used, just lead the discussion and use the tool. This works especially well in companies where quality is not everyone’s favorite activity and seen as an added step and something they do not want to do. It is more important to get the job done than to slap a label on it.

The same holds true for metrics and measurement tools. The term KPI (Key Performance Indicator) can make some folks cringe. But if you know what is important to your business and the success of the company, this also becomes an easy task to define, track, measure, and make adjustments. Quality professionals need to understand their customers just as much as everyone else does. Know how much quality jargon your team and coworkers can handle and use it appropriately. Whether you call it a business goal, quality metric, KPI, or something else, it is a measurement that is important to the business and this concept is easy to understand and sell. Measure what you determine is important to the overall success of your project, program, and company. Do not measure something for the sake of measuring it. Charts and graphs are a wonderful tool that can visually show data. But remember the point of using this tool. To show a picture that can be interpreted into information and to open up a discussion. If your chart does not lead to a good discussion and information about your process, result or goal, why are you doing it? Ask yourself, what is the purpose of this chart? What does it tell us? Will anyone use this to make a decision? If your chart is not providing a purpose and helping make informed decisions, then you might not have the right tool or need the chart. Unless your goal is to prove you know how to make a colorful graph in excel, do not throw one in your presentation.

A typical goal is to track failure rates of product shipments after they left the manufacturing facility. This is good information to have. Issues were tracked as errors when something was missing from the shipment or items that were incorrect

or the wrong item was shipped. Issues were classified as wrong or missing. There were several factories making product shipments and there were multiple product lines involved. The goal was to determine if one factory had more accurate shipments than another. This was calculated by a number of wrong or missing shipments out of the total number of product shipments made. For example, when the raw data is reviewed, the number of wrong or missing shipments is relatively low estimated at 100 for the entire year across all factories. Now to make sure the factories were compared to each other equally, the incidents were converted into a defect parts per million (DPPM) metric. Lets think about this. There were 100 incidents all year and an estimated 50,000 items shipped during that year. That is, a 0.002 % defect rate annually across all factories. Breaking down the failures to each location could potentially make the rate even lower for some factories and maybe slightly higher for others. But overall, it does not make sense to convert a relatively low number into a larger one. If it is estimated that there are ten incidents a month, converting that number into a DPPM rate increases the expected failures to hundreds or thousands. Making the situation look worse than it is does not make sense. If we convert our 100 defects a year into a DPPM number, we get 2,000 defects per million. Presenting 100 failures looks a lot better than 2,000. Especially if shipping one million products a year is unrealistic for your business. The defect rate is low, and that fact should be highlighted, not convert it to a larger number to make it look worse. Factories can still be compared to show if one is performing better than another using a percent metric and looking at failures as a percentage of shipments for a given month. This presents a more accurate picture and makes further data analysis easier. If you are not going to drive some sort of improvement from the metric, what exactly is the reason you were collecting the data? In this case, the goal should be zero wrong shipments and zero missing shipments. Even with the low numbers, the data and percent are meaningless if it is not understood why the shipments are wrong or missing items. There is value in a high level picture, and it is important to know if there is a problem at a particular factory, but drilling down to determine root cause is even more important. This is a perfect example of how you can complicate a metric and spend time making charts and graphs that are not providing useful information.

Keep it simple. Use common sense and apply metrics and charts that yield useful data. Data is not information as this example demonstrates. In the above example, there was a run chart, there was a comparison, but it could not be determined what the issues were and why they were occurring. So what one factory had a lower rate than the other? There were still failures at both locations and the reasons why they were occurring was unknown. Improvements cannot be made to eliminate the problems from occurring with product shipments and this should have been the purpose of the data collection. Just because the run chart was in control and within the control limits does not necessarily mean it was a good result. At first glance of the data, one should have been able to see that the number of shipment errors was so low that no further analysis or charting was necessary but rather to try to understand what issues were occurring and why. There were only about ten issues to analyze in any given month and that should have been an easy task to undertake.

All the tools and concepts presented over the years from all the experts have not changed all that much. The names may have been changed a little or someone tweaked it a little, but the concept is the same. And they all work if used properly and for the right reason. You have to know how to pick and choose the tools that are right for you and your company and what you want to accomplish. Tools can even be customized to make it your own. I knew one company that did not like fish bone diagrams, so they made them into sharks. You have to implement your quality system for the right reason and believe in it and make it work for you.

The bottom line that any quality professional will tell you is that a good quality program can save you time and money. That is after all, the goal of the quality concepts starting with Deming, Juran, and the other founders of the field. A quality system can reduce wastes in waiting, routings, rework, and it can produce a good product that will ultimately result in happy customers and employees.

This was the basis for the Malcolm Baldrige National Quality Award. The concept was if you focus on making a good product by following repeatable processes that you constantly strive to improve, business results in the form of revenue, customer satisfaction, and employee satisfaction will ensue. In this model, customer satisfaction is a result, not a goal. The Baldrige Award was a new way of looking at the typical business model and how we thought our goals and results should be organized. To some degree, the award follows a logical, common sense approach to operating a business.

A good quality program customized to fit your business needs coupled with the right core values can deliver an excellent product that leads to positive business results. When the focus is on creating a product that is well designed and tested, manufactured consistently with an attention to detail and providing excellent customer support as needed after the product reaches the customer, success is inevitable. Quality has to be built into every company activity and every part of the process from the time raw materials come in the door to the time the finished product is shipped out of the door and everything in between.

Sometimes folks like to make simple things complicated for no good reason. Do what makes sense for your business. A quality system or program can be as complicated or as simple as you want it. Why anyone chooses to create and implement an overly complicated burdensome quality system is beyond me. Yet, people do it all the time.

Customize, customize, customize. Choose the tools that are right for the job and do what makes sense for your business. Your quality system should be one that helps your business grow, be efficient and effective. If your quality system is difficult or burdensome, it is your own fault and you can fix it. Do not be afraid to wipe the slate clean and start over. That is the beauty of continuous improvement. You can decide your quality system is not working as effectively as you want it to and you can change any procedure or process you want, any way you want to.

Stick with the basics, the timeless proven methods will work no matter what new name they are given or how you decide to put your own spin on them.

Author Biography



Author's Short Bio and Perspectives

Name: Barbara J. Santiano

Date of Birth: August 1970

Residence: Burlington, MA

Education: BS- Marketing from University of Massachusetts—Dartmouth, MS- Total Quality from Anna Maria College, JD—Massachusetts School of Law

Current Job: Director of Quality, NEC Energy Solutions, Inc.

Previous Jobs: Senior Quality Engineer—MKS Instruments, Senior Quality Manager—Global External Manufacturing, EMC Corporation, Corporate Quality Manager, Bus-Tech, Inc.

Introduction to Quality: While working at a small non-profit and considering returning to school, I received a post card for a Master's Degree in Total Quality. I went to the information night and thought the program was in line with everything I believed

about customer service and delivering a good product and was a compliment to the concepts learned in my undergraduate marketing program. I did not hesitate to enroll. Six months into the program, the school referred me for a position in quality working as a consultant.

Favorite Definition of Quality: Quality is whatever the customer says it is.

Major Contributions to the Field: Training and educating others.

One Word Defining the Future of Quality: Standard.

One Trend Defining the Future of Quality: Customers expect quality. It isn't an option, no matter what the price, the highest quality and performance from the product or service are expected.

Impact of Feigenbaum Medal: The biggest impact has been being asked to contribute to this book.

Favorite Book on Quality: This one, of course.

Plans for the Future: Continue to work in the quality profession and teach others how to use the tools and realize the benefits of quality.

Quality Quote: Try it. You'll never know if you don't try.

Development of Strategic Quality Metrics for Organizations Using Hoshin Kanri

Elizabeth A. Cudney

Abstract Often in organizations there is a disconnect between the long-term strategy and their improvement efforts. Organizations may have a vision; however, their daily continuous improvement activities may not be linked to the vision. Conversely, an organization may be very organized with respect to daily functions but not have any long-term goals. Effective planning is critical for creating an organizational strategy and vision. Lean and Six Sigma are both powerful tools for continuous improvement that are widely used to increase quality, productivity, profitability, and market competitiveness. Six Sigma is focused on reducing variation using a problem solving approach and statistical tools. Lean focuses on eliminating waste and improving flow using various Lean principles and their respective approaches. As stand-alone tools, companies can achieve strong improvements. However, many companies realize suboptimal results due to poor project selection and inappropriate tool selection. The Lean and Six Sigma philosophies drive continuous improvement; however to realize significant improvements, organizations must link their continuous improvement efforts to their strategic vision and goals. Therefore, an integrated approach to process improvement using Lean principles and Six Sigma begins with a strategic approach to identifying gaps between the current and future state. The final goal of this integration is to holistically optimize the entire process of value flow by eliminating waste and controlling variation. One of the techniques that companies can adopt to systematically make progress in implementing the organization's vision into its daily process is Hoshin Kanri. This technique encourages employees to reach the root cause of problems before searching for solutions, create sustainable plans for implementation, incorporate performance metrics, and take appropriate action for implementation. Though developed in Japan, this technique is based on Deming's classic Plan-Do-Check-Act improvement cycle. Hoshin Kanri drives the long-term strategic vision of the organization down throughout all levels of the organization.

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Lean and Six Sigma initiatives are then tied to the long-term success of the organization. In this chapter, Hoshin Kanri will be presented as a strategic approach to implementing Lean and Six Sigma to achieve long-term results.

Introduction

Organizations must focus on speed, efficiency, and customer value to be globally competitive. Lean and Six Sigma are both powerful tools to improving quality, productivity, profitability, and market competitiveness. Six Sigma is focused on reducing variation using a problem solving approach and statistical tools. Lean focuses on eliminating waste and improving flow using various Lean principles and their respective approaches.

Six Sigma is a customer focused continuous improvement strategy and discipline that minimizes defects and variation toward an achievement of 3.4 defects per million opportunities in product design, production, and administrative processes. It is focused on customer satisfaction and monetary results by reducing variation in processes. Six Sigma is also a methodology using a metric based on standard deviation (σ). Six Sigma targets aggressive goals. The goals of Six Sigma include developing a world-class culture, developing leaders, and supporting long-range objectives. The Six Sigma strategy consists of five main phases including Define, Measure, Analyze, Improve, and Control (DMAIC).

Lean principles have enabled corporations to achieve significant economic benefits while improving quality, costs, and cycle time. The lean approach is focused on the identification and elimination of waste in production, product development, and service industries. Although lean principles were originally developed by Toyota for automobile manufacturing, they are increasingly being applied to businesses with many routine processes in support functions.

Lean focuses on eliminating waste and improving flow using various proven methods initially pioneered by the Toyota Manufacturing Company under the banner of the Toyota Production System (TPS). Lean is applied to improve the flow of information and material. Waste stems mainly from unnecessary delays, tasks, costs, and errors. The seven wastes of lean include overproduction, transportation, inventory, processing, waiting, motion, and defects. These wastes can also be applied to support functions such as procurement, engineering, invoicing, inventory control, order entry, scheduling, accounting, and sales.

The primary focus of lean is on the customer, to address value-added and non-value-added tasks. Value-added tasks are the only operations for which the customer is ready to pay. The idea in creating flow in lean is to deliver products and services just-in-time, in the right amounts, and at the right quality levels at the right place. This necessitates that products and services are produced and delivered only when a pull is exerted by the customer through a signal in the form of a purchase. A well-designed lean system allows for an immediate and effective response to fluctuating customer demands and requirements. Lean manufacturing tools that are

most commonly used to eliminate waste and achieve flow are value stream mapping (VSM), standard work, 5-S housekeeping (5S), single minute exchange of dies (SMED), total productive maintenance (TPM), and visual management.

As stand-alone tools, companies can achieve strong improvements. However, many companies realize suboptimal results due to poor project selection and inappropriate tool selection. An integrated approach to process improvement using Lean principles and Six Sigma begins with a strategic approach to identifying gaps between the current and future state. The final goal of this integration is to holistically optimize the entire supply chain by eliminating waste and controlling variation. One of the techniques that companies can adopt to systematically make progress in implementing the envisioned process is Hoshin Kanri.

Hoshin Kanri offers an effective way to tie the long-term strategy of the organization to process improvement efforts. Typically, organizations select their kaizen events and process improvement projects based on where they currently feel pain. If they had a recent rash of external defects, they might decide to initiate a Six Sigma project as a corrective action response to the customer. Significant time and money are involved in running a Six Sigma project and Six Sigma may not be the best tool. In addition, even though this is currently where the company is feeling the pain, it may not be the true highest priority project in looking at the big picture within the organization or the supply chain.

What is needed is a systems approach that focuses on the long-term vision and strategy of the organization. The time, talents, and money of the organization should focus on improvements that will impact the flow of the entire organization and supply chain. As such, organizations should consider systems thinking using the theory of constraints to ensure a broad impact on the entire organization and supply chain.

This will also greatly increase the momentum of improvement. As improvements are completed, more people throughout the organization and supply chain will notice their impact. More people will experience the effects quicker, which will drive the participation and involvement of more people.

Current State and Practices

Many organizations on the lean path begin by creating a value stream map. In doing so, a current state map is developed of how they presently create value for their customers. This is then followed by the creation of an enhanced future state map, incorporating best practices in their processes through research and benchmarking. The final goal is to optimize the process of value flow throughout the supply chain by eliminating waste and controlling variation.

However, achieving full implementation of the enhanced future state value stream map is far more complex than developing it. One of the techniques that companies can adopt to systematically make progress in implementing the envisioned process is Hoshin Kanri. This technique encourages employees to reach the root cause of problems before searching for solutions, creating sustainable plans for

implementation, incorporating performance metrics, and taking appropriate action for implementation. The Hoshin Kanri technique is based on Deming’s classic Plan–Do–Check–Act (PDCA) improvement cycle.

In addition, Hoshin Kanri cascades the overall strategic vision of the organization throughout all levels enabling employees to see how they fit into the big picture of the organization and through the supply chain. This linkage aligns everyone on the same strategy and vision. By focusing employees on a common direction, the improvements can have a much larger impact in considerably less time. Think about a small team whose members understand what they need to do and how effective they are in working together. Imagine a company of 500 or 1000 employees or larger all working together to achieve a common goal throughout the supply chain.

Proposed Methodology

The Lean and Six Sigma philosophies both drive continuous improvement. To realize significant improvements, however, Lean and Six Sigma efforts must be linked to the strategic vision and goals of your organization. This will ensure the most appropriate projects are implemented to achieve the greatest gain for your organization.

An integrated approach is needed to maximize and sustain gains that utilize long-term strategic planning to identify process improvement activities and then select the appropriate technique. This section presents a five-phase methodology of how the implementation of the enhanced future state value stream map can be expedited using Hoshin Kanri. A graphical representation of the five phases is given in Fig. 1 (Cudney 2009).

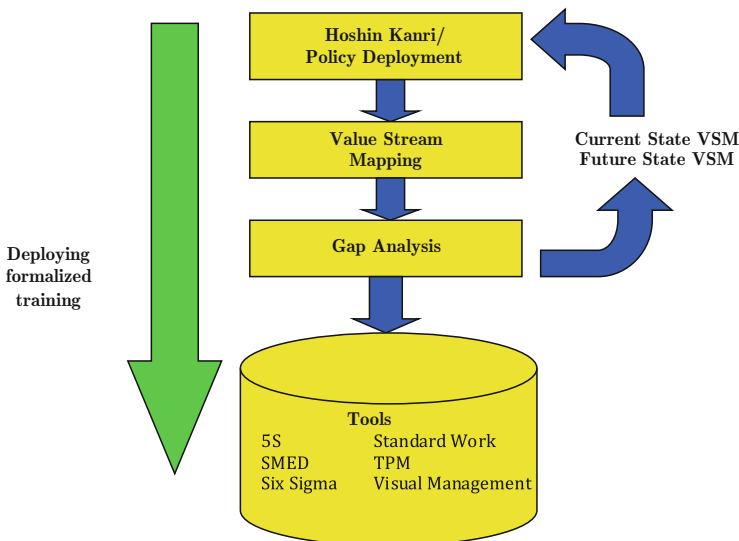


Fig. 1 Proposed integrated methodology

Step 1: Deploy Formalized Training

Start by deploying formalized lean and variation reduction (or Six Sigma) training. Formal training should include training on the technique followed by an implementation project.

Step 2: Hoshin Kanri/Policy Deployment

At the same time as deploying the formalized training, capture the strategic goals of the organization. The goals are then driven down through the organization and throughout the supply chain and integrated into the daily activities.

Step 3: Value Stream Mapping

VSM is performed to identify all value-added and non-value-added steps required to bring a product from raw materials to the customer. Map the current state of the supply chain to identify how the process is currently operating.

Step 4: Gap Analysis

Perform a gap analysis between the current state, future state, and strategic goals to identify kaizen bursts for areas of improvement. Develop the future state to design a lean flow. Prioritize the identified kaizen bursts.

Step 5: Perform Kaizen Events

Standard work and 5S must be top priority as these techniques lay a foundation by improving consistency. Using the prioritized kaizen bursts develop action plans or schedules to perform the kaizen events or Six Sigma projects.

Hoshin Kanri

Japanese quality thinking began before 1645. Miyamoto Musashi (translated in 1974) wrote a guide to samurai warriors on strategy, tactics, and philosophy entitled *A Book of Five Rings*. Musashi was a Japanese swordsman who became legendary for his duels and distinctive style of swordsmanship. Musashi, known to his fellow Japanese as *Kensei* (Sword Saint), was a Kendo master who lived from 1584 to 1645. In his book, Musashi states, “If you are thoroughly conversant with strategy, you will recognize the enemy’s intentions and have opportunities to win.”

A corporation’s strategic plan must be integrated with the macrolevel value stream map to identify the optimal improvement opportunities in the supply chain. This promotes strategic thinking. Often improvement activities are identified with silo thinking. The effects on other systems or processes within the organization and the supply chain are not considered. Improvements in one area can have a negative impact on another business area.

Hoshin Kanri began in Japan in the early 1960s as statistical process control (SPC) became total quality control (TQC) (Akao 2004). Hoshin Kanri is most

commonly referred to as Policy Deployment (PD). “Hoshin” means *shining metal, compass, or pointing the direction*. “Kanri” means *management or control*. Here’s an overview of what policy deployment is and does:

- PD is a systems approach to management of change in critical business processes.
- It is a methodology to improve the performance of critical business processes to achieve strategic objectives.
- PD improves focus, linkage, accountability, buy-in, communication, and involvement in a corporation.
- It links business goals to the entire organization, promotes breakthrough thinking, and focuses on processes (rather than tasks).
- PD is also a disciplined process that starts with the vision of the organization to develop a 3- to 5-year business plan and then drives down to one-year objectives that are deployed to all business units for implementation and regular process review.

PD is a business management system designed to achieve world-class excellence in customer satisfaction. The system, beginning with the voice of the customer, continuously strives to improve quality, delivery, and cost. The system provides the necessary tools to achieve specific business objectives with the involvement of all employees.

As shown in Fig. 2, you should take the voice of the customer to drive your business targets. Then, using PD as your management strategy, you should drive down this strategy throughout all levels of your business including the supply chain

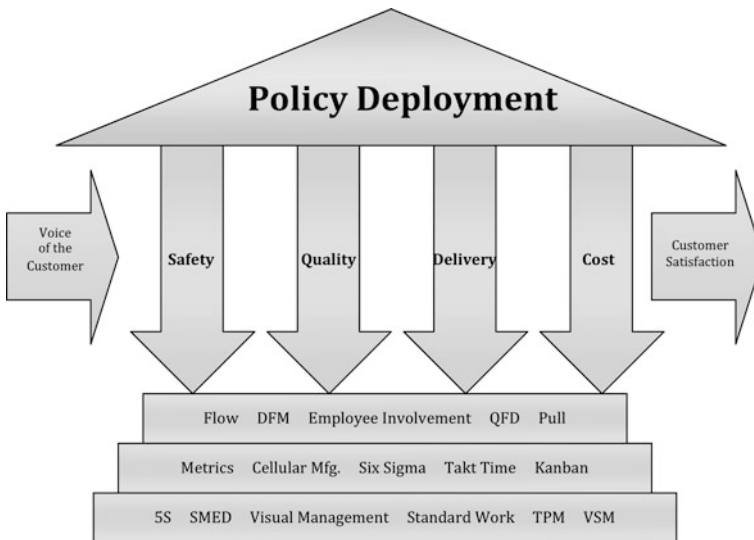


Fig. 2 Strategic business system

to focus on safety, quality, delivery, and cost. Then using foundational Lean Six Sigma tools such as pull, 5S, SMED, standard work, TPM, and VSM, you can focus on continuous improvement. This leads to improved customer satisfaction, which further leads to improved sales growth for your organization.

Health Care Example

In order to illustrate the proposed methodology, a case study is presented to show how the strategic goals are cascaded into the daily operations. The case study was developed for the healthcare industry. A group of Lean Black Belts from the healthcare industry was interviewed to develop a representative case study.

The focus of this case study was to develop metrics to assess and monitor daily operations in the healthcare industry. The healthcare industry has transitioned to a patient-centered care focus. Therefore, the metrics were developed such that they enable hearing, displaying, and acting on the voice of the patient as much as possible. The metrics are patient-centric and timely in order to highlight areas for improvement. Specifically, the metrics address areas of value for the patient's experience of care. This case study presents how these metrics were developed using Hoshin Kanri.

The Hoshin Strategic Plan Summary provides a picture of the overall strategy of an organization and how the strategy cascades throughout all levels of the organization. The linkage is clear on how each strategic goal is measured and who has the ultimate responsibility. The team developed four strategic goals for the organization including improve financial performance, be the community hospital/provider of choice, achieve total workforce engagement, and become nationally recognized for clinical excellence and quality.

The team then used the strategic goals to develop several core objectives for the organization. Next, the team reviewed the relationships between their strategic goals and their core objectives to ensure all of their strategic goals were being addressed properly. The team identified the appropriate metrics that would tie directly to their core objectives. The metrics were quantitative to indicate whether the process improvements have an impact on the overall organization and are trending in the right direction. Finally, the team assigned ownership of the core objectives to specific members of their team. Figure 3 provides the Hoshin Strategic Plan Summary.

The leadership team next focused on developing the Hoshin Plan Summary. As shown in Fig. 4, the team carried down the strategic goals and owners from the company's Hoshin Strategic Plan Summary. The short-term and long-term goals are linked back to the measures outlined in the Hoshin Strategic Plan Summary. The team decided to have their short-term focus on improvements in the next year and the long-term goals two years out.

Using this information, the team was able to determine their implementation strategies based on their strategic goals. For example, in order to become nationally

Using the information from the Hoshin Strategic Plan Summary, Hoshin Plan Summary, and implementation strategies, the team can then use their current state value stream maps to identify opportunities relating to the implementation strategies. This links the department level value stream maps to the high-level value stream maps.

Typically organizations determine their process improvement activities by asking each individual team to decide what is needed. Therefore, the kaizen event and Six Sigma project selections were up to each team leader. The current state value stream maps were used to drive the improvement project identification, but there was no clear method for prioritization of the projects. This results in some improvement gains, but not in a big impact on the organization.

By linking the process improvement efforts to Hoshin Planning, this healthcare organization can now prioritize their process improvement activities to realize a significant impact. Using the information from the Hoshin Plans and current state value stream maps, the team led the effort to drive down the strategic goals into their daily management and action plans. One of the core objectives was reducing hospital acquired adverse events. The department managers reviewed the current state maps with their teams to identify improvement opportunities for reducing hospital acquired adverse events. Figure 5 illustrates the action plan for implementing safety huddles at the beginning of each shift. As a team, each department would discuss goals, tactics, targets, and milestones to aid in developing strategies that would impact the overall organization. Each department would develop a Hoshin Action Plan for each of these strategies.

HOSHIN ACTION PLAN		
<p>Core Objective: Reduce hospital acquired adverse events</p> <p>Management Owner: CNO, CMO, CI</p> <p>Department: Nursing</p>	<p>Team: Josh, Caroline, Wesley</p> <p>Date: 10/16/14</p> <p>Next Review: 11/16/14</p>	
<p>Situation Summary: Daily operational briefs have been shown to be highly effective to predict and lessen risk or harm. By performing safety huddles at the beginning of every shift, nurses can manage by anticipation and prediction and make effective decisions when critical issues arise. This allows the frontline leaders to make real-time adjustments to keep patients safe. Therefore, safety huddles will be used to communicate knowledge of patient risks to the incoming patient care team.</p>		
<p>Short Term Goal: 25% reduction in hospital acquired adverse events by 2014</p> <p>Long Term Goal: 40% reduction in hospital acquired adverse events by 2014</p>	<p>Tactics: Standard work for safety huddles at the start of shift</p>	<p>Targets and Milestones: Reduce the time for safety huddles from 3 min to 2 min by February 2013</p>

Fig. 5 Hoshin action plan

HOSHIN IMPLEMENTATION PLAN														
Team: Nursing														
Strategy Owner: Wesley														
Date: 10/16/14														
Core Objective	Performance	Schedule and Milestones												
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Reduce hospital acquired adverse events	Target	25%	2.1%	4.3%	6.4%	8.5%	10.6%	12.7%	14.7%	16.8%	18.9%	21.0%	23.1%	25.0%
	Actual	2.8%	2.4%	2.8%										
	Target													
	Actual													

Fig. 6 Hoshin implementation plan

Next, the team cascaded these strategies down to the Hoshin Implementation Plan, also called a bowling chart. In order to determine the target improvements, the team would revisit the current state maps for the respective processes to determine the baseline for the improvement strategy. By understanding the current process performance level, the team is able to determine the target improvement. Using the monthly improvement targets, the team manages the projects and monitors trends using the bowling chart as shown in Fig. 6.

Conclusions

Hoshin Kanri is a methodology to capture strategic goals and integrate these goals with your entire organization’s daily activities. Effective planning is critical for the long-term success of a corporation. Hoshin Kanri is the system that drives continuous improvement and breakthroughs. In order for organizations to reap maximum gains from their process improvement efforts, they must link their strategic goals with their business system and use this to select the appropriate the Lean or Six Sigma technique.

Using an approach to link Lean and Six Sigma into the strategic vision of the organization enables the organization to realize the full benefits. Lean and Six Sigma projects that are selected based on their impact on the entire organization have the most effective results. For Lean and Six Sigma efforts to be successful, employees must be adequately trained and coached to develop their skills. Effective mentoring is essential for employees to understand and implement new techniques. Therefore, the approach linking Hoshin Kanri with Lean and Six Sigma must address training and coaching to develop the skills of employees at all levels of the organization.

It is critical to ensure that your strategic vision cascades down throughout your organization into the daily activities of all employees. This clear linkage enables an

organization to move in a common direction with common goals. When employees understand the direction of the organizations, they can make the appropriate improvement and decisions that will enable long-term success. By using the strategic vision, an organization can employ Lean and Six Sigma techniques to eliminate waste, improve flow, and reduce variation.

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Author Biography



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Masters of Engineering, Mechanical Engineering, University of Hartford, 2000.

Bachelor of Science, Industrial Engineering, North Carolina State University, 1996.

Current Job: Associate Professor of Engineering Management and Systems Engineering, Missouri University of Science and Technology

Previous Jobs: Jacobs Vehicle Systems, Bloomfield, CT

Senior Manufacturing Engineer/Manufacturing Manager/Six Sigma Black Belt

Dana Corporation, Whitsett, NC

Process Engineer/Industrial Engineer

Introduction to Quality: My father was an industrial engineer. I really learned a lot about the impact of quality and quality engineering by watching him and listening about his work. My first job out of college was as a Quality Engineer for the Spicer Axle Division of Dana Corporation.

Favorite Definition of Quality: Quality is a *customer determination* which is based on the *customer's actual experience* with the product or service, *measured* against his or her *requirements—stated or unstated, conscious or merely sensed, technically operational or entirely subjective*—always representing a *moving target* in a competitive market.

—Dr. Armand Feigenbaum (1920–2014)

Major Contributions to the Field: Promotion of the education and communication of important quality concepts through publications, presentations, and teaching.

One Word Defining the Future of Quality: Evolving

One Trend Defining the Future of Quality: Enhancing the global quality of life

Impact of Feigenbaum Medal: I have been able to meet and learn from global leaders in quality.

Favorite Book on Quality: *The Goal: A Process of Ongoing Improvement* by Eliyahu M. Goldrat

Three Publications:

Cudney, E., Furterer, S., and Dietrich, D., (2013) *Lean Systems: Applications and Case Studies in Manufacturing, Service, and Healthcare*, CRC Press, New York, NY.

Cudney, E., and Furterer, S., (2012) *Design for Six Sigma in Product and Service Development: Applications and Case Studies*, CRC Press, New York, NY.

Cudney, E., (2009) *Using Hoshin Kanri to Improve the Value Stream*, Productivity Press, New York, NY.

Plans for the Future: Continuing to engage a global audience in furthering the field of quality

Quality Quote: Quality is not a destination; it is a continuous journey to meeting and exceeding ever changing customer requirements.

Customer Experience Driving Quality Transformation

Kandy Senthilmaran

Overview

What Is Quality?

The common definition of quality means fitness for intended purpose. This can be translated into products or services meeting engineering specifications or service level agreements (SLA); thereby, the focus is on reducing the customer defects. I have come across many scenarios where the specifications or the SLA's itself was mediocre and it barely met the needs of the customer. Even though there may be robust quality framework, standards, and processes deployed to meet those specifications and SLA's, maintaining a low cost of poor quality, but it might not help to achieve long term customer loyalty and in an era of innovative companies leapfrogging ahead of the completion, the boundaries between innovation, quality, and customer satisfaction are no longer distinct. In this chapter, I am sharing my perspective of the new dimensions of quality and why it is important to put customers first in everything we do and drive breakthrough and disruptive innovation as a way of winning hearts and minds of our customers in twenty-first century.

Key Challenges in Quality

Quality faced many significant challenges in the last century and I have bulleted some of the key challenges which I have experienced in my career. I believe quality has made tremendous progress in the last century in making sure that the customer

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gets what they want and value for what they are paying for. In business terms, quality is perceived a key risk mitigation from costs due to defective products, warranty costs, litigation costs, ongoing maintenance, etc., but it is the end customer who really reaps the benefit of a good quality product or a service. We know of many companies that have invested in quality in great rigor which resulted in their products and services winning in the market place and sustaining customer loyalty. Quality is primarily used as a tool for cost reduction in business rather than a mechanism for building long lasting value for the customer. This, I believe, still remains as a key challenge for the quality movement.

- Overhead
- Perceived value
- Not built into culture
- Lack of senior management support
- Lack of role based trainings
- Challenges in quantifying the benefits of quality
- Lack of broader quality career path

How Quality Has Evolved in the Last Century?

From an inspection-based defect detection and prevention methodology to do-it-yourself federated model so as to keep the cost of quality resources at a minimum. The whole notion of quality is to reduce the cost of poor quality in product development and service costs. Quality is considered an inhibitor to innovation where very large company that have mastered quality and are famous for their excellent quality products and services and continuous innovation. Using a tight span on process and procedures focusing on throughput and less defects could limit the flexibility in experimentation result in culture shift of the employees, where they are no longer having the appetite to do new things as the reward model is based on doing things faster, better, and good quality. Even with achieving all these things, we would still be missing out on capturing the changing customer needs. In many big corporations, there are exclusive innovation groups which are responsible for developing and incubating new products and services. Since they are detached the internal listening systems through which they get information is very rigid and does not reflect the new customer usage scenario's or applications, they are handicapped to rely on limited amount of credible information to drive new information resulting in improved capabilities with additional features but not a breakthrough product or a service. There is a role for quality in ensuring that the disciplined application of rules (standards), schools (training) and tools drives ever lasting customer value and loyalty. It used to be that way, with very less competition and in a non-global market. In another anecdotal example, we have seen our earlier generation having worked for the same employer for their whole lifetime and

there was pride in doing so but in the background it reflects the situation which I just described. Quality as a movement in the last century was very successful in making sure customers got what they wanted and it was not that effective in helping the business to maintain their competitive edge by breakthrough and disruptive innovation. Essentially failing to be on the top of the customer's real and perceived needs and how to productize it.

What Is the Role of Quality Engineer?

The role of quality engineer is in most companies focused as a custodian of a standard or a methodology and entrusted to maintain the quality of a product or services as a mechanism for customer assurance if the quality of product or service that the customer is getting is good. Most of the quality engineer's activities are focused on inspecting, auditing, testing, reviewing artifacts, etc., which essentially is considered as a non-value added cost. The strategy of quality engineer should be focused on prevention than detection and without proper instrumentation of the process and people behavior, this role gets positioned as a checkpoint or inspection role depending on the resources the company is investing in quality and its culture. The inherit flaw in this model is not about the role of quality but about the objective. Quality is focused on making sure we have process and procedures which takes the customers' requirements and develops them into a product or service which the customer wanted at a good quality level, basically boiling down to meeting or exceeding customer needs.

New Dimensions of Quality in twenty-first Century

The challenge for quality now is that the customer needs or the perceived value is changing dynamically and we do not have product cycles which is not in line with these rapidly changing needs to keep up with their expectations or keep with new competitors who are very innovative and able to win the hearts and minds of the customers through breakthrough technology and great user experience. When the market and the customer needs are moving at this rapid pace and the traditional company with quality methodologies with a cycle of 12–18 month product cycle to get new features and capabilities with great quality to customers does not excite them anymore. We are in a truly global market nowadays and the rate of innovation with disruptive technologies can happen anywhere and anybody's garage, which will end up capturing the imagination of the customers and will be considered as the new baseline for the customer needs. So the struggle is not only if the quality engineers are making sure that we are addressing the stated customer requirements in the product or service but whether have other proactive channels which listen to

customer sentiments and needs and sensitised the customers changing needs and also support and drive disruptive innovation.

What Does Quality Mean Now?

Quality is about empowering people to do their job effectively and without restraining the system with non-value added process and tools. It is just an enabler and an influencer of the outcomes and not a rigid standards and inspection based methods driving the process to produce the outcome.

Customer Satisfaction as Fountain Head of Quality

Customer satisfaction is an instrument to level set on the quality efforts of the company by directly hearing from the customers on how satisfied they are with the product or the service they received, which was delivered through the quality efforts from the company. Customer satisfaction is typically measured through surveys at the end of customer interaction or through various intervals in a customer engagement or relationship. The survey will cover many facets of the business dimensions and explore customer's reaction to different attributes satisfying customer needs and capture them on a Likert scale. Each of the drivers of these satisfaction attributes or drivers can be directly correlated to the key business, products, or services aspects. By understanding whether the customer is satisfied and dissatisfied lets the business to determine where they would need to focus on their quality efforts. The quality of the product or service is the key drivers of this model with other drivers focusing on the value, usability, effectiveness, competitiveness, support, etc. The biggest drawback in using survey as a primary channel for measuring customer satisfaction is that it is a lagging instrumentation and the water is already under the bridge method. By the time we get the data and perform the analytics, it is a significant challenge to separate the signal from the noise (on the lines of Genichi Taguchi's signal to noise ration were the irrelevant data can distort customer's key sentiments). Typically there will be one or two surveys per customer per year to avoid over survey, the customers who did not have a good experience would have moved on to the competitors and probably would have discussed their experience with their friends and family, in a way influencing them in not doing business with the company having a cascading impact. There is also a factor that many customers take surveys when their satisfaction levels are not that great with that company and they want to let them know their negative experience.

Landscape Swift

The divergent needs of customers are getting converged into a devices and services world. Example, setting the living room temperature through a thermostat or enabling the security system, even feeding the pets through a smart device (phones, tablets, etc.). In the early part of this century, we started mechanizing activities to increase productivity, efficiency, and better quality and also to enable mankind to move up in the human need fulfillment value chain to help us to focus the energy in much more evolutionary and innovative things. Human race progressed at a much rapid pace due to the invention of technologies which are applied for different purposes providing us with a world of numerous devices and appliances as a way of life. The focus of quality was on making how to manufacture these devices with reduced or no defects. We had to develop and deploy standards, bodies of knowledge, frameworks, methodologies to ensure consistency, and repeatability of what can be accomplished. We had different flavors of ensuring a less defective product by both preventive and corrective actions. All this with a mindset of defined product attribute. Customer needs were still in silos in terms of key functions or activities enabling human's work and life model. A great quote from Henry Ford, regarding the first car he ever built: "If I'd asked my customers what they wanted, they'd have said a faster horse." Quality got defined when we started innovating in every field and the respective customers started experiencing the capabilities of different innovative technologies. Essentially when the modern quality movement started getting shape, it was with the definition of quality as meeting customers' expectations. The key factor in this scenario is that customers' expectations were to an extent static and was evolving in an incremental manner over the period of time with new features and takes a big leap with the advent of new technologies. So defining and ensuring quality is not a big deal as every manufacturer has internalized their own quality standards and systems and with the cost-price and customer segment model, they were able to cater and meet the expectations of the customers with defined quality goals. The way we measured whether we met customers' needs are through the defects or problems which customers raise and a likely customer satisfaction survey at the sales or services interaction. At the most we do a special purpose interaction with the customer to see what else they would want from the product or to make sure the upcoming capabilities in the product is in line with what they want.

Lets fast forward to the current state of how we are with fulfilling customer needs. I believe its important to move beyond the standards and methods-based quality culture to customer experience-based active and rapidly evolving, seamlessly enabling with inbuilt quality mechanisms to strongly drive innovation resulting in meeting and exceeding the stated customer needs and defining new customer needs and experiences. To do this, understanding the changing customer needs are paramount as well as shorter and effective product development cycles.

Author Biography



Kanthassamy (Kandy) Senthilmaran is the Director of Customer and Partner Experience for WW Services business in Microsoft Corp and has been a Master Black Belt with Microsoft Quality and Business Excellence before taking up this role. Kandy has 15 years of experiences in quality and customer experience and worked in many standards, frameworks, methodologies (ISO, SEI CMM, CMMi, BS7799, COBIT, ITIL, Six Sigma, SOX etc.) throughout his career. His is the 2009 ASQ Feigenbaum medalist and currently the ASQ Software Division Chair.

Author's Short Bio and Perspectives

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Introduction to Quality: Included in the ISO audit readiness team at the last minute, when the internal lead auditor got sick and the whole experience encapsulated me when I saw the senior executives got grounded with the audit experience, and I saw quality as a better lever to positive impact business outcomes if done proactively. There is no looking back now.

Favorite Definition of Quality: In God we trust, all other bring data—W. Edwards Deming

Major Contributions to the Field: Development of CTQ driven Dashboard Metrics methodology

One Word Defining the Future of Quality: Innovation

One Trend Defining the Future of Quality: User Experience

Impact of Feigenbaum Medal: Increased the desire to learn, contribute and grow more

Favorite Book on Quality: Out of crisis—W. Edwards Deming

Three Publications: Bunch of technical articles with ASQ

Plans for the Future: In the process of co-founding a start up on big data analytics

Quality Quote: Customer Value is Quality

The Role of Learning and Exploration in Quality Management and Continuous Improvement

Jamison V. Kovach

Abstract The long-term health of any organization depends on its commitment to continuous improvement, which is one aspect of quality management. While we do not yet fully understand the link between quality management and organizational performance, previous research suggests that this relationship is often moderated or mediated by other factors. This chapter specifically considers the role that learning and exploration play in continuous improvement efforts within organizations. The aim of this discussion is to extend previous considerations regarding the juxtaposition of stability and reliability (control) versus exploration and innovation (learning) in quality/continuous improvement; hence, this work first explores learning in terms of a process that generates knowledge that organizations use to build competitive advantage. This chapter also examines the need to balance between the exploitation of existing knowledge and the exploration of new alternatives. This discussion suggests that learning and exploration are mutually beneficial when considered within the context of continuous improvement. In addition, these concepts compliment traditional notions of quality management/improvement and, therefore, expand our thinking about these topics.

Keywords Quality management · Continuous improvement · Learning · Knowledge creation · Exploration

Introduction

Quality management consists of a comprehensive organizational philosophy, embodied in principles, practices, and techniques, that strives to effectively fulfill customers' needs (Dean and Bowen 1994). Sitkin et al. (1994) defines the principles of quality management as customer satisfaction, continuous improvement, and

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system view. While we do not yet fully understand why some organizations prosper, while others fail, scholars have suggested that superior organizational performance can be attributed to the adoption of quality management practices (Flynn et al. 1995; Douglas and Judge 2001; and Kaynak 2003). Research has shown that quality management has a direct effect on organizational performance, but that these effects are often moderated or mediated by other factors, such as organizational structure, core practices, and contextual variables (Nair 2006).

Because the long-term health of any organization depends on its commitment to continuous improvement (Juran 1969; Ishikawa 1985; Deming 1986), this chapter will discuss the role that learning and exploration play in continuous improvement. The key premise of this chapter is that to improve existing business processes, we must first truly understand how the process/system works; hence, learning and knowledge creation are a vital component of quality management (Kolesar 1994). What results is typically an improved process, which is often characterized as being standardized and/or predictable. This suggests that variation in business processes is undesirable. On the other hand, continuous improvement requires creativity. Because creative success in uncertain environments depends on generating enough variations of ideas that at least some will yield desirable results, creativity involves variance-seeking behaviors (McGrath 2001). And so, as an extension of the previous discussion by Sitkin et al. (1994), this chapter discusses the juxtaposition of stability and reliability (control) versus exploration and innovation (learning) in quality/continuous improvement efforts.

To begin this discussion, the next section provides an overview of the concept of learning in conjunction with continuous improvement. This section argues that the output of learning is the creation of knowledge and that the cultivation of organizational knowledge supports the development of competitive advantage. The issue is, however, how can organizations ensure they do not limit their quality/continuous improvement efforts to simply the exploitation of exiting knowledge? Because problem solving entails methods beyond those that focus merely on process standardization/control, this chapter goes on to discuss the notion of exploration within continuous improvement efforts. This section examines several exploratory activities such as being creative, generating ideas, conducting experiments, and reflecting on results. Finally, the chapter concludes with some closing remarks and suggests related areas for future research.

Learning and Continuous Improvement

Quality management involves problem solving (Winter 1994); hence, continuous improvement naturally involves learning (MacDuffie 1997; Sitkin et al. 1994) and the creation of knowledge (Osterloh and Frey 2000; Mukherjee et al. 1998). Learning is the process through which knowledge is created (Vera and Crossan 2003), and according to Linderman et al. (2004), understanding knowledge is an

important step in linking quality management practices to organizational performance. The knowledge-based view of business strategy supports knowledge as the chief asset of any organization (Grant 1996b, 1996a). How an organization functions is directly related to the knowledge it possesses (Davenport and Prusak 1998), and performance is influenced by the differences in knowledge resources between organizations (Kogut and Zander 1992); hence, Davenport and Prusak (1998) suggest that, “the only sustainable advantage a firm has comes from what it collectively knows, how efficiently it uses what it knows, and how readily it acquires and uses new knowledge” (p. xiv).

Previous research has found that learning provides valuable contributions that lead to the successful execution of improvement projects (Mukherjee et al. 1998; Choo et al. 2007b; Anand et al. 2010; Kovach and Fredendall 2013). In improvement projects, team members work together to generate ideas for improvement, test their ideas, and implement solutions (Juran 1974; Gitlow et al. 1995). To guide these efforts, firms often use approaches such as Plan–Do–Check–Act (PDCA), which Deming (1986) generally referred to as a “learning cycle,” or the Six Sigma methodology, which is a structured process for obtaining the knowledge necessary to improve products/services (Breyfogle 1999). The specific practices used in improvement projects often include scientific methods for systematically identifying and reducing sources of customer dissatisfaction (e.g., flowcharts, cause-and-effect diagrams, etc.) as well as tools to monitor and analyze work processes (e.g., control charts, Pareto charts, etc.) (Hackman and Wageman 1995).

Mechanisms of Knowledge Creation

Using Polanyi’s (1966) distinction between tacit and explicit knowledge, the theory of knowledge creation (Nonaka 1991) prescribes how organizations develop competitive capabilities through the exploitation of existing organizational knowledge. Explicit knowledge is objective in nature and is easily communicated through systematic language, such as words, figures, or numbers; therefore, it can be codified in archives and databases without difficulty. Tacit knowledge, often taking the form of insights, intuitions or hunches, however, is subjective and intuitive in nature making sharing difficult through standard forms of communication: hence, this type of knowledge is often not codified, and instead resides unconsciously within individuals. However, the value of personal knowledge can only be realized by an organization when this knowledge is shared with others in the firm (Nonaka and Takeuchi 1995).

Nonaka’s (1994, 1991) framework of knowledge creation depicts how knowledge is developed and shared within organizations through a constant exchange of tacit and explicit knowledge. This framework uses a spiral model to describe the dynamic interaction between organizational members that converts existing forms

of knowledge into new ideas and concepts. The transmission of tacit and explicit knowledge from individuals to groups within an organization and beyond is driven by four mechanisms: (1) *socialization* (i.e., from tacit to tacit—sharing experiences or perspectives), (2) *externalization* (i.e., from tacit to explicit—participating in meaningful dialogue), (3) *combination* (i.e., from explicit to explicit—integrating concepts or knowledge), and (4) *internalization* (i.e., from explicit to tacit—the traditional notion of learning).

As described in Table 1, Linderman et al. (2004) used these concepts to define how the principles of quality management (Sitkin et al. 1994) support knowledge creation. The premise of Linderman et al.’s (2004) work is that Nonaka’s framework provides “...a useful theoretical lens to understand how quality management practices result in creating knowledge, which in turn improves performance” (p. 593). While Linderman et al.’s (2004) work suggests how some practices support knowledge creation, Table 2 provides more detail about this issue. This table includes descriptions about practitioner’s views of some well-known quality improvement tools and provides insight regarding how these tools help to cultivate knowledge within improvement projects.

It is interesting to note the congruencies between practitioners’ insights regarding these tools and the definitions linking quality management practices and knowledge creating mechanisms originally defined by Linderman et al. (2004). For example, several tools are sighted by practitioners for encouraging or facilitating interaction between organizational members, which is a key point made by

Table 1 The links between knowledge creation and quality management (adapted from Linderman et al. 2004)

Dimensions of quality management	Mechanisms of knowledge creation			
	Socialization (Tacit → Tacit)	Externalization (Tacit → Explicit)	Combination (Explicit → Explicit)	Internalization (Explicit → Tacit)
Customer satisfaction	Interaction between organizational members and customers	Articulating or conceptualizing customers’ needs	Analysis of customer data/information	Monitoring and providing feedback regarding customer information
Continuous improvement	Interaction between organizational members in improvement activities	Articulating improvement ideas in the form of theories, concepts, or cause-and-effect reasoning	Analysis to support problem understanding and diagnosis	Process monitoring and control
System view	Interaction between heterogeneous organizational members	Conceptualization of the purpose and aim of the system by the organization	Synthesis of information from heterogeneous sources by the organization	The organization’s conformance to its purpose, aim, and strategy

Table 2 Practitioners' insights regarding how quality improvement tools facilitate knowledge creation

Quality improvement tools	Mechanisms of knowledge creation			
	Socialization (Tacit → Tacit)	Externalization (Tacit → Explicit)	Combination (Explicit → Explicit)	Internalization (Explicit → Tacit)
Affinity diagram	Fosters interaction between organizational members to determine issues surrounding a problem	–	Supports the organization and categorization of qualitative data (i.e., ideas, issues, etc.) from multiple sources	By reflecting on the content, individuals gain insights about all the issues involved in a problem
Cause-and-Effect diagrams	Fosters interaction between organizational members to identify potential causes of a problem	Facilitates sharing ideas about potential causes of a problem Supports articulation of improvement ideas in the form of cause-and-effect reasoning	Helps bring together all ideas from various areas/sources that may be related to the cause of a problem	By reflecting on the content, individuals gain insights about possible cause-and-effect relationships related to a problem
Failure modes and effects analysis (FMEA)	Fosters interaction between organizational members to determine potential failures associated with a product/process	Supports articulation of (proactive) improvement ideas in the form of cause-and-effect reasoning	Examines potential failure modes, effects, and causes from multiple perspectives	Documents product/process potential failure modes, effects, causes, and corrective actions so it can be reviewed by others at a later time
Flowcharts	Fosters interaction between organizational members to come to a consensus about the way a process operates	Through dialogue, individuals express their views regarding how the process operates	Represents a collective view (from many perspectives) about how a process operates	By reading procedures, observing the process, and/or discussing it with others, individuals gain insights about how the process operates Visually communicates the process steps to others

(continued)

Table 2 (continued)

Quality improvement tools	Mechanisms of knowledge creation				Internalization (Explicit → Tacit) Helps decipher what the critical issues are
	Socialization (Tacit → Tacit) Fosters interaction between organizational members to identify potential causes/outcomes of a problem	Externalization (Tacit → Explicit) Supports using cause-and-effect reasoning to identify the relationships between elements of a problem	Combination (Explicit → Explicit) Helps bring together input from various sources about cause-and-effect relationships	Internalization (Explicit → Tacit) Helps decipher what the critical issues are	
Interrelationship diagram/Relations diagram	Fosters interaction between organizational members to identify potential causes/outcomes of a problem	Supports using cause-and-effect reasoning to identify the relationships between elements of a problem	Helps bring together input from various sources about cause-and-effect relationships	Helps decipher what the critical issues are	
Prioritization matrices	Fosters interaction between organizational members to identify solutions to a problem	Supports brainstorming to develop decision-making criteria	Incorporates the opinions of many into the decision-making process	Helps identify the best solutions	
Process decision program charts (PDPCs)	Fosters interaction between organizational members to develop and assess a plan	Supports articulation of cause-and-effect reasoning when identifying possible problems within a plan	Examines plan elements and possible problem areas from multiple perspectives	Helps determine and address problem areas within a plan	

Linderman et al. (2004) regarding how continuous improvement supports knowledge creation through socialization. However, an instance where there are some differences occurs for internalization. For this particular mechanism of knowledge creation, the insights from practitioners for several tools focus more on the idea of reflective activities and learning versus process monitoring and control, as defined by Linderman et al. (2004).

Building Competitive Advantage

Understanding the mechanisms for learning and cultivating knowledge is critical because organizations that know how to effectively use their knowledge assets to improve performance can distinguish themselves from their competitors (i.e., create a competitive advantage) (NIST 2009; Fiol and Lyles 1985; Grant 1996a, 1996b). Choo et al. (2007a) has previously described how improvement projects produce both tacit and explicit knowledge. It is important, therefore, to consider both of these types of knowledge since the intangible assets of any organization, which are hard for competitors to imitate, are a mixture of formal and tacit elements (Barney 1991; Bessant et al. 2001; Dooley 2000).

The exploitation of existing organization knowledge is an important part of building a sustainable competitive advantage, but there are also other factors that need to be considered. As Sitkin et al. (1994) point out, organizational effectiveness hinges on the capacity to balance the conflicting goals of stability and reliability (control) with those of exploration and innovation (learning). This idea is reinforced by the concepts discussed within ambidexterity theory, which suggest that success depends on an organization's ability to balance between both exploitation and exploration (Tushman and O'Reilly 1996). That is, because most situations involve both the exercise of control and the capacity to learn, managers must be able to balance between learning (i.e., exploration) and control (i.e., exploitation) based on the context/situations in which they work.

While this notion may seem to promote adaptability as a positive management strategy, it has been suggested that adaptation tends to increase the exploitation of existing knowledge and reduce the exploration of new alternatives (March 1991), which may (unintentionally) inhibit organizational performance. Therefore, in addition to employing concepts of control/exploitation, improvement efforts should also encompass exploration-oriented, learning behaviors that involve search, risk taking, and innovation (March 1991) in order to improve organizational performance; hence, creative, variance-seeking activities are needed particularly in situations with high task uncertainty where methods for control/standardization (i.e., exploitation) are not applicable.

Exploration and Continuous Improvement

People tend to learn through an iterative process of designing, carrying out, reflecting upon, and modifying actions (Dewey 1922). For example, quality/continuous improvement efforts often rely on a series of experiments where experience-based trial-and-error or “ad hoc” experimentation generally drives the problem solving process (Mukherjee et al. 1998; Bohn and Lapre 2011); hence, learning involves exploration or experimenting with alternatives in order to develop new knowledge (March 1991). In addition, learning encompasses practices associated with seeking information and asking questions (Choo et al. 2007b); hence, learning is not necessarily a planned and controlled process. However, work that results in learning yields, “...better organizational knowledge, which in turn can lead to changed behavior, and subsequently to improved performance” (Bohn and Lapre 2011, p. 192).

Compared with exploitation, however, exploration is risky because it takes time, and there are no guarantees about the results that will be obtained. That is, the returns on exploratory activities are often uncertain, distant, and sometimes negative (March 1991). As shown in Table 3, Sitkin et al. (1994) previously compared and contrasted the concepts of control/exploitation and learning/exploration for each dimension of quality management. It is interesting to note that the descriptions regarding system view allude to the concepts of first- and second-order/single and double loop learning discussed previously by Argyris (1976) and Argyris and Schon (1978).

Table 3 A comparison of different orientations to quality management (adapted from Sitkin et al. 1994)

Dimensions of quality management	Control/Exploitative orientation	Learning/Exploratory orientation
Customer satisfaction	Develop understanding of needs of known customers (including providers and internal customers) and respond to those needs	Recognize new pools of customers emerge as new products are developed and provide active “education efforts” aimed at altering customers’ perceptions of their needs
Continuous improvement	Enhance exploitation (control) of existing capabilities and resources	Emphasize improving learning capability, including identifying new skills and resources, exploring new arenas, learning from exploration, and withstanding the failures associated with exploration
System view	Learn how to deliver better quality given a set of clear parameters, which requires increased involvement of suppliers, employees, and customers	Define basic goals and criteria for measuring the achievement of standards, which requires increased diversity in order to challenge existing assumptions

First-order learning is the primary form of learning that is practiced in most situations, and it involves more effectively exploiting familiar skills in addressing known problems; hence, the fundamental design, goals, and activities of the organization are not questioned. Therefore, first-order learning tends to inhibit exploration (i.e., learning new things), and it is often difficult to change. On the other hand, second-order learning involves asking questions about changing the fundamental aspects of the organization; hence, inquiry is seen as a strength as opposed as a weakness (i.e., asking questions because you do not know something). The reality is, however, that second-order learning is difficult to adopt because it involves changing learning behaviors, and it is often viewed as revolutionary when practiced in environments where the predominant method of learning is first order (Argyris 1976; Argyris and Schon 1978).

Creativity and Ideation

One of the hallmarks of exploration-oriented, learning behaviors includes creative thinking. This type of work is “mindful,” meaning that creativity involves “using your mind to figure things out” or “requiring brainwork...reflection” (Victor et al. 2000, p. 109). Creativity has previously been defined as “the production of novel and useful ideas,” and it is the foundation for all innovation (i.e., the successful implementation of creative ideas within an organization) (Amabile et al. 1996, p. 1155). Because creative success, particularly in uncertain environments, depends on generating enough variations of ideas that at least some will yield desirable results, a variety-generating, learning approach may be best (McGrath 2001). Specifically, this type of approach may help to increase the breadth of scope used when searching for new alternatives/solutions to problems (Katila and Ahuja 2002).

In addition, improvement efforts within organizations often involve subject matter experts in conducting brainstorming sessions to generate creative ideas. However, perhaps more can be done to further enhance idea generation and selection processes within improvement projects using more formal/detailed brainstorming approaches such as double reversal (i.e., developing ideas to make the problem/issue worse and then reverse the ideas generated) or the charette procedure (i.e., dividing teams into smaller groups to develop ideas about multiple problems/issues and rotating facilitators between groups so each group provides input about each problem/issue) (Tague 2005). In addition, other creativity tools like brainwriting (i.e., nonverbal brainstorming methods) or lateral thinking (De Bono 1993) are useful methods for generating ideas. And, once ideas are obtained, improvement teams need to evaluate ideas in order to select the ones they will pursue further using group evaluation and decision-making tools, such as multi-voting, nominal group technique, and/or prioritization matrices (Brassard and Ritter 2010).

Experimentation and Reflection

Experimenting with new alternatives provides an opportunity to obtain feedback so as to learn how various options work in practice, and it is often performed on a small-scale prior to full-scale implementation of an improvement/process change; hence, this type of approach is often considered a useful learning process/knowledge generating activity (Leonard-Barton 1995; Lapré and Van Wassenhove 2001). To encourage/motivate the use of experimentation within organizations, it is important that individuals/teams feel psychologically safe and perceive that they have support for taking risks as part of their improvement efforts (Amabile et al. 1996; Edmondson 1999).

Psychological safety is the “shared belief that the team is safe for interpersonal risk taking” (Edmondson 1999, p. 354). While psychologically safe environments tend to encourage exploration, without this sense of safety, team members often avoid risking loss of face, discussing errors, and asking for help (Choo et al. 2007b; Edmondson 1999); hence, the potential for threat or embarrassment may inhibit exploration-oriented, learning behaviors (Argyris 1982). For teams facing change or uncertainty, however, theoretically the rewards typically outweigh the risks associated with experimentation because teams can learn about their work environment/processes by testing various alternatives (Edmondson 1999). Success, however, cannot be guaranteed.

In general, exploratory activities often involve methods comparable to the type of experimentation traditionally used in product development efforts. In these environments, prototypes (i.e., artifacts) are designed, built, and tested. The results of these tests are analyzed to provide additional information/ideas (i.e., feedback) that may be explored further (Thomke 1998). This type of approach is known as sequential experimentation (Bohn and Lapre 2011), and it is through this type of approach that improvement teams are often able to determine what needs to be done to solve a problem.

The exploration of experiences is driven by problem solving efforts and feedback processes (Hoyrup 2004) and this type of thinking leads to developing new understandings (Boud et al. 1985; Edmondson 1999); hence, reflection, which is sometime referred to as “sense-making,” is another important mental activity that is the driving force behind organizational learning (Woerkom 2003). Essentially, reflection is the conscious and voluntary reconstruction of knowledge that establishes beliefs upon a firm basis of evidence and rationality (Dewey 1922) that involves thinking about experiences, mulling them over, and evaluating them. However, this process requires that individuals have time and space to reflect on their work in order to learn from it. Furthermore, because reflection is imbedded in social interaction, it is important for individuals to reflect together in teams. Yet, when acting in routine ways individuals/teams tend not to reflect, and, therefore, may miss the opportunity to learn from the experience (Hoyrup 2004).

Conclusion

In an effort to develop a further understanding about the relationship between quality management practices and organizational performance, this chapter considered the role that learning and exploration play in quality/continuous improvement efforts. The overriding theme of this discussion suggests that learning and exploration are mutually beneficial when considered within the context of continuous improvement. In addition, these concepts compliment the traditional notions of quality management/improvement that focus mainly on standardization/control (i.e., exploitation); hence, organizations that develop methods for effectively aligning their focus between learning (i.e., exploration) and/or control (i.e., exploitation) to match the context/situations in which they work, will likely be more successful than organizations that do not.

Given that scholars have previously identified that organizational knowledge assets are a key element of building competitive advantage, the current discussion raises some interesting questions that suggest potential directions for future research. While mechanisms of knowledge creation that focus on exploiting existing organizational knowledge play an important role in quality/continuous improvement efforts, this approach is mainly appropriate for repetitive/routine processes and typically results in an improved process that is standardized/controlled. For non-routine processes, however, such as those found in job shops, project-based environments, etc., learning and exploration are needed to address the uncertainty faced in these unique/dynamic types of environments.

So, how can we encourage/support/facilitate learning and exploration within improvement teams/organizations? This question likely requires further study. Some sub-elements of this larger question may involve enhancing creativity and/or expanding the use of experimentation within teams/organizations. For example, what can be done to further enhance idea generation and selection processes within teams? In addition, can the exploration of novel ideas be expanded by questioning the foundations on which our beliefs are constructed using critical reflection (Mezirow 1990) and/or double loop learning (Argyris 1976; Argyris and Schon 1978)? Along these lines, perhaps further research is also needed to examine how to improve the perceptions of psychological safety in teams/organizations. These and other questions require further investigation through additional research where future studies may focus on developing explicit models that explain how to align quality management practices with the context/situation in which they are applied.

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Previous Jobs: Product and Process Improvement Engineering, Milliken, Spartanburg, SC, USA

Introduction to Quality: Quality Improvement Methods course in college

Favorite Definition of Quality: Meeting/exceeding customers' expectations

Major Contributions to the Field: I have published nearly 50 journal articles and given more than 60 presentations about my research in quality engineering/management regarding the application of structured improvement methods, such as Lean Six Sigma, Design for Six Sigma, etc., to facilitate learning and organizational improvement. The most notable of this work has been conducted in behavioral/mental healthcare settings. I have also led the creation of an academic and professional Lean Six Sigma training program at the University of Houston. This program has spread quality tools and methods to hundreds of individuals, providing valuable skills for our graduates, as well as professionals in our local community and several in the international community that will strengthen their organization's competitiveness. In addition, I have received an award for my research in an international venue, and my students have received local recognition for our research together. I have also spearheaded innovative pedagogical practices for quality methods, and I have given back to the quality community through my many service activities.

One Word Defining the Future of Quality: Impactful

One Trend Defining the Future of Quality: Inclusion of design/redesign methods as part of process/continuous improvement efforts

Impact of Feigenbaum Medal: Inspiration to fulfill the potential others saw in me early in my career to make a difference in the quality field.

Favorite Book on Quality: Ulrich, K.T., S.D. Eppinger, and A. Goyal, *Product design and development*. Vol. 2. 2011, New York: McGraw-Hill/Irwin.

Three Publications:

Lucas, A.G., Primus, K., **Kovach, J.V.**, & Fredendall, L.D. (2015). Rethinking behavioral health processes by using Design for Six Sigma, *Psychiatric Services*, 66(2), 112–114.

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Plans for the Future: Continue researching and teaching quality at the University of Houston

Quality Quote: Do it right the first time!

The Efficienti: Quality Professionals of the Twenty-First Century

Austin S. Lin

Abstract A new group of quality professionals, The Efficienti, are the beneficiaries of a contemporary landscape in which traditional quality tools, combined with modern commerce and technology, can be applied across traditionally disparate areas of knowledge. By founding their actions on the tenets of Serve, Enable, and Connect, Efficienti use the reapplicable nature of quality methodology to bridge entire clusters of knowledge, fostering epistemological synapsing: new pathways created between disciplines are not traditionally well traversed. This work establishes the foundational thinking of The Efficienti, twenty-first century quality professionals improving and innovating quality by scaling the benefits of one particular area of knowledge across a wider scope of professional practice previously considered to be.

Keywords Quality assurance · Epistemological synapsing

Introduction

For every best, there is a better.

That is the fundamental belief of The Efficienti.

The growth of human knowledge continues to expand at cosmological rates, enabling connectivity across boundaries of scale and magnitude previously unsurpassable by the methodologies of even just a few decades ago. The Efficienti thrive at the intersection of past and present, employing reapplication, correlation, and continuous improvement to create new business landscapes beyond those traditional limits. This practice has its roots in the discipline today referred to as quality assurance, yet its differentiating characteristic is its ability to span its application beyond discipline-bounded definitions.

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And who makes up this group of practitioners whose namesake sounds like it was picked from an old draft of a Dan Brown novel? Thankfully, there are no DaVinci codes to crack. In fact, the only secret to be unlocked is not the “who they are” but the “how they think.” The Efficienti can be defined as more of a mindset, or way of practice, than as a secret society. Yet it is certainly a group.

That is why you are already a member.

Contemporary quality professionals are metaphorical bridge-builder across diverse areas of knowledge, a practice that includes the following actions in their approach to organizational excellence. The Efficienti are this new category of quality professionals, those that may not even necessarily require the word “quality professional” to appear on a business card or email signature in order to embrace its practice. This practice is as such:

- *Serve* The supreme tenet of quality assurance is absolute, uncompromising service to the end customer, consumer, or user. While at its foundations this criterion has never changed, the ways in which this state of service is attained in the modern millennium, have changed.
- *Enable* Quality is an enabling force linking the endeavors of research and development, crossing multiple fields of study, to the customer via rigorous work processes and quantifiable customer-critical results. To know something is to measure it. To measure it is to enable its improvement and advancement.
- *Connect* The only real disciplinary study is interdisciplinary study. The domain of The Efficienti is a world in which in-depth mastery is attainable alongside a rich tapestry woven from diverse areas of knowledge. Mastery in any one area of knowledge is strengthened by building linkages to other lesser known areas of knowledge. Together, that is how new pursuits of innovation materialize into tangible, practical results. The Efficienti seek out doors in the traditional walls that delineate functions, job descriptions, and industries. The doors are there, but it takes a discerning bit of innovative courage to pick the locks.

Maxwell’s Demon and Other Gatekeepers

Traditional areas of knowledge are oftentimes segregated, by virtue of how people learn and master knowledge, into individual compartments. Pedagogically speaking, this is seen as necessary in order to build competency in any one area of knowledge.

To use an example from classical thermodynamics, let us turn to a demon: Maxwell’s Demon. In this thought experiment proposed by James Clerk Maxwell, one of the discipline’s early founding fathers, consider a container with two compartments separated only by a frictionless gate. On one side of the gate are particles of Gas A; on the other side, particles of Gas B. The particles of Gas B never “know” that Gas A, yet when the gate is lifted, equilibrium occurs over time and the blend of Gas A and Gas B are now homogenized.

To have Gas A and Gas B to reorganize themselves back into exclusive, single identity sides of their respective compartments is to violate the second law of thermodynamics, which indicates that entropy in the universe must always increase, not decrease. Yet Maxwell's Demon makes this possible by remaining vigilant at the gate, allowing mixtures of A and B to self segregate when approaching the passageway. Over time, the compartments are restored to their original, single gas sides of the compartment.

If one were to equate quanta of knowledge to these two gases, The Efficienti understand the importance of allowing different gases to mix, to collide, perhaps to even bond and react, forming newer gases impossible to appear were it did not for each constituent's exposure to each other. The Efficienti are not gate keepers, but gate openers, allowing areas of knowledge that were previously never "aware" of each other's existence, isolated in their compartments, to suddenly discover entire new compartments and classes of knowledge thriving there. Having seen both isolated states, The Efficienti are also able to understand where the individual quanta of knowledge once originated from and how they can be leveraged both in isolation as well as in mixture. Now, in imagining an infinite number of compartments and an infinite number of different quanta of knowledge, The Efficienti are facilitators of this inter-category awareness. Through each lift of the gate, opportunities to innovate and improve in previously uncorrelated ways, become real possibilities.

Tools of The Efficienti: Missionaries for the Future

The purpose of the quality professional is that of a missionary, never ceasing until the practice of quality becomes so integrated in all practices, that there is no longer such thing as a quality department, a quality division, a quality function. The goal of every quality professional is to eliminate the quality profession. Processes can be generalized into anything with an input and an output. That transformative or influential distance separating input from output is the process. To Serve, Enable, and Connect, Efficienti adapt past tools to present technology.

Any process with a customer to be served is a quality process. Quality will be rendered unnecessary as a standalone category upon full integration into every behavior within every process. In grasping onto modern quality tools, adapting them at scale in a new industrial landscape is at the heart of The Efficienti mission. Consider the following implications when present day quality practices are scaled to global orders of magnitude.

Lean Methods

- *Now* Lean is about eliminating waste. Traditional lean method rooted out sources of losses within manufacturing environments, following a combination

of human and machine behavior and mapping out the greatest savings resulting from the loss elimination.

- *Next* Reaching beyond how work processes within a business's four walls are linked, lean methods will now be applied to the linkages between countries. Processes once spanning hundreds of people will be scaled to span millions of people, in different time zones, in different cultures, in different geographies. Using lean to look across a global scale will reveal tributaries that spill into blue oceans.

Six Sigma Methods

- *Now* Six Sigma is about eliminating variation. Through the textbook "5 Ms": huMan, Machine, Material, Method, environMent, reducing variation means increasing standardization of best practices.
- *Next* While the challenges of variation reduction and elimination within a businesses' immediate control can already seem insurmountable without careful execution. The scale of variation control will continued to be magnified.

Big Data and Statistical Process Control (SPC)

- *Now* Over the past three decades, quality analyses have evolved from large tomes of statistical tables and charts of acceptable quality levels to computer driven quantitative tools. While that made creating control charts much faster, assessing the appropriate sample size and physically making predictive decisions based on those samples are still a part of the common practice of SPC.
- *Next* With memory becoming cheaper and processor speeds becoming faster, the presence of big data, single data sets on the order of petabytes (10^{15} bytes) or even higher, create the need for the efficient analysis of such data sets. In a traditionally sample-size driven practice of SPC, analyzing only a sample of the data will evolve to the easy analysis of literally all data collected. Lower order predictive models based on statistical samples will evolve into algorithm or artificial intelligence (AI) predictive behavior to extract trends and exceptions to each massive dataset.

Global Supply Chain Thinking

- *Now* Supply chains deliver goods and services from their smallest constituents to their final recipients.
- *Next* Every link of the supply chain can be discretized into a dense collection of supplier–customer relationships. Gains will result from a whole as strong as its

collection of constituent micro chains. When this is repeated with discipline across each individual linkage and then scaled across the entire supply chain, the quality of the result will also increase.

Epistemological Synapsing

How do Efficienti add value in such a scaled world? The Efficienti are global citizens, energized and aware at the opportunities that enable the reapplication of quality practices to novel problems. The Efficienti do this by championing *epistemological synapsing*. The term is derived from “epistemology,” the philosophical study of the origins and validity of knowledge, and “synapsing,” which borrows from the development of neurological connections in the nervous system. So epistemological synapsing refers to extending connectivity beyond a traditional cluster of knowledge to create or strengthen previously unseen or under-utilized linkages between different areas of knowledge.

In 2009, Johan Bollen, Herbert Van de Sompel, Ryan Chute, and Lyudmila Balakireva of Los Alamos National Laboratory illustrated how different areas of scientific knowledge (Bollen et al. 2009) can be connected (Fig. 1). By following links of citations between a diverse array of academic journals, their modeling resulted in a visual “clickstream map” of the many subdisciplines of science.

Close node disciplines were predictably closely organized with regards to citations. Physical chemistry and statistical physics, for example, were found to be clustered closely next to organic chemistry and analytical chemistry. However, less predictable new connections between clusters arose whenever one particular journal cited another journal not traditionally within that field’s scope of practice. Organic chemistry connecting to international studies, for example.

By traversing multiple nodes of disciplines traditionally studied independently, one could conceivably find a pathway linking chemical engineering to classical studies, from hydrology to nursing.

This finding creates two exciting behavioral contexts in which Efficienti thrive:

- (1) Understanding the proximal differences between different clusters of knowledge in order to best leverage reapplication and new connections using quality knowledge.
- (2) Being the pioneers that use quality skills to tread across the thin, far threads of connectivity spanning to opposite ends of the knowledge constellation.

Understanding which quanta of knowledge create stable connections within such a knowledge map can be better understood by innovating at these interfaces. New discoveries can be made that could potentially impact all three nodes and every branch of knowledge in between. The quality profession is already seeing the benefits of such practices: applying lean methodologies born of manufacturing to the business of healthcare organizations (Going Lean in Health Care 2005); using Six Sigma methods to reduce the time needed to load the shipping containers across

Lucas equates the landscape of knowledge to a “giant jigsaw puzzle” with each area of knowledge represented by its own puzzle piece. The boldest of thinkers, says Lucas, will migrate toward the edges of their particular piece, at its interstices. “So the interstices between disciplines are always where the action is.” writes Lucas. “It is where the best practitioners go to invent the future.”

The Efficienti are at their best when challenged with crossing the edges of these puzzle pieces. The tools mentioned previously are the methods by which Efficienti can enter entirely new fields of study, find a foothold using those quality tools, and then begin innovating in that space.

An example of the organizational benefits of exploring the interstices of knowledge is the composition of the industries represented by Section Chairs and Committee Leaders of the New York/New Jersey Metropolitan Section of the American Society for Quality (ASQ); this make up is likely similar to the compositions of many ASQ sections because of an organically developed diversity stemming from the nature of the quality profession.

Representing 500–600 quality professionals in the Greater New York City region, these section leaders alone, active in the 2011–2012 leadership board, already represent the following industries:

- Insurance
- Transportation
- Construction
- Pharmaceuticals
- Consumer Goods Manufacturing
- Academia–Engineering Sciences
- Academia–Biological Sciences
- Statistics and Operations Research
- Food and Beverage
- Auditing and Regulatory Compliance

From 2009–2013, it was the different perspectives and connections made by this diverse background that enabled the NY/NJ Metropolitan Section to launch the first student section in the region with the New Jersey Institute of Technology (NJIT). This was fostered by introducing NJIT students, the majority of them pursuing Masters of Engineering Management degrees, to the diverse industries represented by members of the parent ASQ section. By meeting just a cross-section of Metropolitan leaders, students were able to see how the skills they were learning, such as program management and Six Sigma methods, were being applied. In 2012, the Metropolitan Section formally joined the ASQ National Healthcare Special Interest Group (SIG), which exists to promote and reapply lean tools borne of manufacturing to the growing complexities of modern healthcare management.

By applying quality tools in disciplines once many knowledge nodes away from traditional quality, the same gains quality exacted in industrial settings can now be unleashed in new contexts, benefitting society in new ways.

The Concept of Rational Sampling Applied to Fields of Knowledge

In statistics, the term rational sampling is used to refer to sampling from a homogeneous set; that is, sampling from within the same distribution of data from within the same population. Rational sampling is violated when, in thinking that one's sample is being drawn from one distribution, it is really being drawn from another, separate distribution. In statistical process control (SPC) terms, violations of rational sampling are typically indications that the process has shifted, that in fact, an entirely new distribution has diverged from the original one.

Efficienti model these statistical shifts when thinking of different fields of practice. Analogous to the statistical example, consider two fields of study: mathematics and genomics. Each “distribution” of knowledge contains its constituent details. The distribution curve of mathematics may include algebra, differential equations, advanced techniques such as knot theory. Genomics, itself a subdiscipline of larger distributions such as biology, contains the molecular biology and physics of DNA behavior as one of its numerous knowledge areas. In a 2000, W.Y. Qiu from the University of Science and Technology of China, described one such intersection between two distributions of knowledge: the application of mathematical knot theory to model and understand the behavior of DNA formation (Bureau of Labor Statistics 2012). The rational sampling view would have that mathematicians only look to pure math and that biologists only look to traditional biology. But in breaking rational sampling and allowing mathematics and biology to be simultaneously studied, in some cases forming entirely new disciplines such as applied mathematics, the application of knot theory to DNA structures created new discoveries benefitting both disciplines. The Efficienti are constantly seeking opportunities to violate rational sampling at the epistemological level, seeing where their quality toolset overlaps in knowledge distributions once foreign to their presence. And there, at the overlapping tails of two separate curves: discovery, connectivity, and innovation.

Efficienti look for the first signs of process shifts as signs of possible new linkages between disciplines. This can be illustrated by functional behaviors such as analytical thinking, for example, that cross disciplinary boundaries.

The U.S. Department of Labor uses specific key words (Qiu 2000) to describe the skills used across the varied disciplines of the workforce (Fig. 2). In comparing the descriptions of a lawyer, operations research analyst and financial analyst with those key words of an industrial engineer (the ancestral analog of the quality assurance professional) common functional behaviors span these four disciplines.

By leveraging functional behaviors that Efficienti already have in common with other disciplines, these same behaviors can also be used to further activate the discipline-specific linkages seen in the Los Alamos clickstream map.

Industrial Engineer	Lawyer	Operations Research Analyst	Financial Analyst
Critical-thinking skills. Mathematical skills. Problem-solving skills. Speaking skills. Teamwork. Writing skills.	Analytical skills. Problem-solving skills. Research skills. Speaking skills. Writing skills.	Analytical skills. Critical-thinking skills. Ingenuity. Mathematical skills. Problem-solving skills. Communication skills. Writing skills.	Analytical skills. Communication skills. Decision-making skills. Detail oriented. Mathematical skills. Technical skills.

Fig. 2 Functional behaviors common across industrial engineers, lawyers, operations research analysts, and financial analysts. Functional behaviors, like specific areas of knowledge seen in the Los Alamos clickstream map, can be observed as opportunities to use a common behavior in one discipline to “enter” another discipline by virtue of their commonality

The Greek Apella and the Future of The Efficienti

In Ancient Greece, an assembly of elders and skilled officials formed the *apella*, a council of experts that led the development of entire cities and governance structures. Their experience allowed members to see above any one particular issue and leverage its linkages to other issues and municipal concerns that in total, could best benefit the net direction of the city state it governed.

Contemporary quality has its industrial roots in the post World War II landscape, when large-scale manufacturing of military support was converted to civilian application. And just as nonmilitary industrialization created a new world of quality opportunity to improve customers’ lives, the new era of faster, lighter technology, big data, and global interconnectivity will create the platform for the quality profession’s next evolutionary step. But progress does not wait for individual stakeholders to adapt. Similarly, the customer will always demand quality and will not wait for a quality professional to gradually adapt to that need. The Efficienti are the modern council who strive for connectivity in the name of reapplying the knowledge of other disciplines to each other. The customer remains the beneficiary. The actions of The Efficienti to serve, enable, and connect will define how well integrated quality practices will be into this newly forming society. Possessing skills that are widely applicable across traditionally separate disciplines of practice make Efficienti the natural standard bearers for quality, stimulating epistemological synapsing, creating new ways in which quality knowledge can be used to best benefit the customer.

Continuous improvement means continuous adaptation. With their adaptive agility, thanks to the ability to navigate such adaptations to link one area of knowledge to another, Efficienti will be needed to weave quality thinking into the growth of the field from present to future. The quality field will not disappear, but instead, will become totally and invisibly integrated into this ever evolving fabric.

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Current Job: Supply Chain Quality Engineering in the Tech Industry

Previous Jobs: Procter & Gamble (2000–2014), including the time frame in which my contribution to this collection was written.

Introduction to Quality: While working innocently as a cathode process engineer at a Duracell factory outside of Atlanta, I was asked to take over as the systems administrator for InfinityQS, our statistical process control (SPC) system. I do not remember exactly what my manager said, but it was something along the

lines of, "Boy oh boy, do I have an opportunity for you..."

Favorite Definition of Quality: "Consumer is Boss."—*A.G. Lafley, CEO of Procter & Gamble*. This sentiment reflects the end user obsessiveness that is true at P&G and other high quality, customer-focused companies.

Major Contributions to The Field By Yourself: Building supplier capability by focusing more on cultural behavior and execution, less on policy and procedure.

One Word Defining the Future of Quality: Scale

One Trend Defining the Future of Quality: Faster analysis of mind-numbingly large data sets and as a result, adapting traditional quality tools in new, exciting ways.

Impact of Feigenbaum Medal: It has been my platform for fostering the talent pipeline into quality and engineering roles within a continually challenging economic environment.

Favorite Book on Quality: My autographed copy of *Innovative Control Charting* by Steve Wise and Doug Fair, for reasons both sentimental and psychological.

Three Publications: _____

Plans for the Future: Encouraging other quality and engineering professionals to find their inner Efficienti throughout their own career paths.

Quality Quote: “For every best, there is a better.”

Final Thoughts

Paulo Sampaio and Pedro Saraiva

To edit and write this book was quite challenging but at the same time an honorable task. We received contributions from Quality Professionals with different backgrounds and professional careers in the quality field. Young Quality Professionals that sometime in their lives have been recognized for their achievements and leadership in quality and for their promising careers—definition of a Feigenbaum Medallist. In the next paragraphs, we highlight some of the main contributions provided by each chapter, together with some regards resulting from the additional information provided in the short biographical notes that we also asked them to provide under a common format. In both cases, these final paragraphs provide the editors (intrinsically subjective) to view for some of the main statements and common patterns that were obtained from our own perspective and reading of all the contents covered in the book.

Some Chapter Highlights

The book starts with our own chapter, entitled “Quality: from past perfect to future conditional”, where we point out and explore a set of quality related topics, their contributions, impact and importance to the field, together with geographical visions of quality, its past, present, and future. And we conclude by highlighting some trends and opportunities for the quality movement and its community of professionals.

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Rajesh Jugulum, in his chapter named “Importance of data quality for analytics”, focus on the importance of the quality of data in the analytic process and its contribution to create value to shareholders, customers, employees, and society. In one of his conclusions, Rajesh points out namely that good data together with robust analytical techniques are the key for organizational success, because they support better organization strategic decisions.

The third chapter was written by Denis Leonard, addresses the “Future of quality” and exploits the role of Quality Management to improve the quality of life. It points out that solutions, tools, and approaches to quality are available, but they should be correctly used and applied in the pursuit of a strategic application of quality.

Barbara Santiano writes about using the right approaches and tools to solve problems—“Common Sense, use the right tool for the job”. According to Barbara, the quality concepts, which have been proven and have not changed over time, should be applied to any industry. The most important obstacle regarding quality improvement programs lies in people. Based on a specific example provided, the message is clear—we should use common sense and apply the tools and the approaches that are really useful to solve our problem and improve organization performance, and a good quality system helps it to grow in a sustainable perspective.

The next chapter, named “Development of strategic quality metrics for organizations using Hoshin Kanri”, was written by Beth Cudney. It points out the importance for companies to have an effective planning in order to create an organizational strategy and vision, but have it also deployed in consistent ways. The Hoshin Kanri approach can help in implementing the organization’s vision and convert it into daily processes and functional levels, also integrating the Lean Six Sigma philosophy.

The sixth chapter belongs to Kandy Senthilmaran—“Customer Experience driving quality transformation”. It starts with an analysis of the definition of quality, followed by key challenges faced, its evolution in the last century, and the importance of quality engineers in organizations. Then, several perspectives on the future of quality are presented, focusing the new dimensions of quality in the twenty-first century, the current meaning of quality and the importance of customer satisfaction in today businesses.

Next, Jami Kovach wrote about “The role of learning and exploration in quality management and continuous improvement”. This chapter suggests that learning and exploration are mutually beneficial when considered within the context of continuous improvement. Additionally, these concepts complement the traditional notions of quality management that are often focused on standardization and control.

Finally, Austin Lin contribution is named “The Efficient: Quality Professionals of the Twenty First Century”. This chapter proposes a new generation of quality professionals, which are the beneficiaries of a contemporary landscape where traditional quality tools, combined with modern commerce and technology, can be applied across traditionally separate areas of knowledge. Therefore, twenty-first century quality professionals improve and develop quality by scaling the benefits of one particular area of knowledge across a wider scope of professional practice.

As it was expected and wished for, all the chapters present refreshing views, with a wide variety of perspectives and different focus, thus reflecting a dozen of diverse and very interesting thoughts about quality. Some reflect in more generic terms about the past, present, and future of quality (Paulo Sampaio and Pedro Saraiva, Denis Leonard, Kandy Senthilmaran and Austin Lin), while others are focused more specifically on certain quality approaches and tools, the importance of data in order to better support organizations strategic decisions or the importance of learning in the quality management context (Rajesh Jugulum, Barbara Santiano, Beth Cudney and Jami Kovach). Taken altogether, we believe to have here plenty of room and inspiration for quality professionals to further develop and implement this area of knowledge, but also for all readers to realize the relevance of quality for building a better world, and provide their support in that regard, with plenty of opportunities, choices and challenges available.

The Feigenbaum Medalists

One can easily realize, from the book contents and the short biographical notes provided, that the group of 15 Feigenbaum Medalists recognized so far by ASQ corresponds to a large variety of professional careers that do inspire the way they view quality and have written about it in the previous chapters. In the next paragraphs, we will highlight some of their main curricular features, in order to summarize the wide diversity of pathways followed by this list of nine exciting people in the quality field who have contributed with chapters.

Pedro Saraiva, PhD, the first Feigenbaum Medalist (back in 1998), is Full Professor at the University of Coimbra–Portugal, and holds a PhD in Chemical Engineering from MIT, USA. Pedro developed his career mainly at the University of Coimbra, as a Professor, Researcher, and Vice-Rector, but also, in the most recent years, as a Member of the Portuguese National Parliament or President of the Regional Development Agency for the Central Region of Portugal. He has also founded several companies with different activity focus, assuming a very important role in the promotion of Quality and its application in new domains. Pedro plans his future based on the continuous improvement philosophy—“...today being better than yesterday but worse than tomorrow”.

Rajesh Jugulum, PhD, received the Feigenbaum Medal in 2001. Rajesh is currently Director of Global Data Strategies at Cigna, Adjunct Faculty at the Northeastern University and Graduate Faculty Affiliate Member at the University of Arkansas, Little Rock. In the past, Rajesh Jugulum held several executive positions in quality related areas at Citi Group and Bank of America, and was also a researcher at MIT. Concerning his future in the quality field, Rajesh expects to continue contributing to the development of quality worldwide.

Denis Leonard, PhD, was recognized with the Feigenbaum Medal in 2004. Denis is President of Business Excellence Consulting and holds a professional career mainly developed in companies where he did assume several quality related

positions, together with being a Visiting Assistant Professor at the University of Wisconsin-Madison. For the future, Denis expects to promote quality in the USA and support the American Society for Quality in its role as the Global Voice of Quality.

Barbara Santiano, Feigenbaum Medalist in 2005, holds a Master Degree in Total Quality. She is currently Director of Quality at NEC Energy Solutions, Inc, after being Senior Quality Engineer and Manager in several USA companies. Concerning her plans for the future, Santiano will continue to work in the quality profession and teach others on how to use tools and realize the benefits of quality.

Elizabeth Cudney, PhD, was recognized with the Feigenbaum Medal in 2007. Beth holds a PhD in Engineering Management from the University of Missouri—Rolla. She is Associate Professor of Engineering Management and Systems Engineering at the Missouri University of Science and Technology. Beth's introduction to quality was made by her father, who was an Industrial Engineer. According to Beth, she learned a lot by listening about his work and watching him. Her plans for the future consist in continuing to engage the global audience of quality.

Kandy Senthilmaran, awarded with the Feigenbaum Medal in 2009, holds a Bachelor of Engineering and has a position as Director at the Microsoft Corporation. Kandy is a fan of Deming—"Out of Crisis" is Kandy favorite book on quality, together with his favorite definition of quality—"In God we trust, all other bring data". Concerning his future plans, Kandy is in an ongoing process of co-founding a start up on big data analytics.

Jamison Kovach, PhD, has been recognized with the Feigenbaum Medal in 2010. Jami holds a PhD in Industrial Engineering from the Clemson University. She is currently Associate Professor at the University of Houston. Jami's contributions to the field are mainly focused on the application of structured improvement methods, such as Lean Six Sigma or Design for Six Sigma, to facilitate learning and organizational improvement, mostly in behavioral/mental healthcare settings. Jami had also led the creation of a Lean Six Sigma training program at the University of Houston. Her plans for the future are focused on pursuing research and teaching quality at the University of Houston.

Paulo Sampaio, PhD, stands as the 2012 Feigenbaum Medalist, with BSc and PhD (in this case, under the supervision of Pedro Saraiva) in Industrial Engineering from the University of Minho, in Portugal, where he is right now Assistant Professor. He leads a strong research group in the quality field, and has also collaborated strongly with APQ (Portuguese Association for Quality) and ASQ. He is also very active in teaching and quality promotion initiatives or events, and will keep doing so in order to further contribute for quality to become more and more recognized as a scientific field, as well as a strategic area for organizations.

Austin Lin, 2013 Feigenbaum Medalist, holds a bachelor in Chemical Engineering from the Johns Hopkins University and he is currently Supply Chain Quality Engineering in the Tech Industry. According to Lin, the best definition for quality is "Consumer is Boss", a definition that he learned from A.G. Lafley, CEO of Procter and Gamble, when he was working there (2000–14). In the future,

Lin wants to encourage other quality professionals to find their own “Efficient” through their career paths.

If one now looks for the overall set of 15 Feigenbaum Medalists, and their lives of achievement, some additional remarks deserve being mentioned here:

- The majority of them (8 out of 15) do have a PhD degree;
- Although maybe having a somewhat biased view (both of us, book editors, do come from an engineering background and are faculty members in departments of engineering), we always felt that quality engineering and engineering should play a major role in the field of quality, and therefore in this regard it is quite curious to notice that the majority of the Medalists (9 out of 15) do have an engineering background (3 out of which in industrial engineering and 2 in chemical engineering), followed then by management and marketing (4 out of 15), and mathematics or statistics (2 out of 15);
- As for present professional activities, there is a well balanced share of Medalists that are in academia (6 out of 15), working in companies (5 out of 15) or consultants (4 out of 15), a reality that does seem to indicate that quite fortunately quality is becoming reasonably accepted as a field of knowledge in the world of higher education institutions.

Patterns and Trends on Quality from Feigenbaum Medalists

We have asked each of the 15 Feigenbaum Medalists to provide us some short biographical information, together with several personal views over quality. A closer analysis of their answers, derived from reading all of the replies over the same issue, allows us now namely to come up with a compilation and identification of some patterns related with how they look into the definition of quality, its foreseeable future and major trends, as follows:

- Regarding the definition of quality, there is clear predominance of relating with customers (9 out of 15) from different angles and perspectives, then complemented by its relationship with continuous improvement, effectiveness and efficiency, constancy of purpose, proper measurements and data;
- As for the future of quality, it seems to be strongly connected with the need for adaptation and flexibility under yet unknown contexts (words like uncertainty, evolving, adaptability, resilient, evolving, dynamic, and challenging were used), some Medalists also see it as becoming mandatory and leading to results (impactful, standard, inevitable, strategic), while others relate the future of quality with innovation, data, operations management, and monetization;
- Concerning quality trends, it is curious to notice that the answers build on the previous ones (regarding quality definition and future), but also add new components to it, resulting in an inspiring list containing words such as global,

evolution, strategic, quality at the corporate but also at the national and international levels, mandatory, quality of life, user experience, inclusion of design, integration, data and big data, measurement, efficiency, knowledge economy, comprehensive and partnership.

Last, but Not Least

This book is full of contributions from a group of quite interesting quality professionals, whose diversity of backgrounds, life experiences, and geographical location does lead to refreshing and creative views over the past, present, and future of quality. Regardless of all this variety of contributions and authors, we do share a common set of values, the same passion and enthusiasm for Quality, and the fact that the Feigenbaum Medal recognition played a quite significant role and represented an unforgettable moment in our lives.

Just by looking at the summaries of biographical elements and keywords connected with quality, one can see that there are plenty of opportunities ahead and choices available for all of us in the quality community, as well as many moderately young pioneers that work very hard and on a daily basis for quality's present to become closer and closer to its desired future, which needs to be ambitious, comprehensive, and made inevitable, regardless of all present uncertainties, that must be converted into opportunities for further quality development, implementation, and awareness.

We have always believed that this book might push its readers into the collective challenge of building the quality's present and future, by providing well informed inspiration for doing so. Now that its contents have become a reality, this seems to be confirmed through the richness of ideas covered coming from some different fresh views provided by a quite selective group of people particularly well positioned to do so. Indeed and in the end, we are quite happy with the results obtained after converting a fuzzy dream into the tangible reality provided by the book that we now have made available and ready for you to read. As we anticipated and expected, it does provide quite powerful and inspired "Quality in the Twenty First Century: Perspectives from ASQ Feigenbaum Medal Winners". Let us all make the best possible use of such views in order to promote, apply, and define the role of quality in the world and make sure, that by doing so, Earth will become a planet of ever increasing levels of quality, quality of life, quality of products, quality of processes, quality of organizations, quality of people, quality of places and communities, that is, in summary, a better world. This is pretty much the common attitude that we found out among all the Feigenbaum Medalists that with this book we would like to see shared by as many people as possible. In doing so, we will also pay the best possible tribute to Armand Feigenbaum, whose life inspired and meant a lot to all of us, fully dedicated to this never ending mission that we also try to pursue, at our own level, scale and daily lives.

Feigenbaum Medalists (Non-Authors)

Short Bios

Short Bio and Perspectives

Daniel Zrymiak has over 22 years of experience in quality and is currently working in Accenture. Daniel’s diverse career in Hong Kong, Germany, and Canada has combined business services, manufacturing, medical software, and web commerce solutions. He also taught software quality at the University of BC, the BC Institute of Technology, and Kwantlen Polytechnic University.

Daniel is a Fellow Member in ASQ, a Regional Director for ASQ Region 4 (Canada), and he received the ASQ’s Feigenbaum Medal and Testimonial Award. He is certified by ASQ as a Six Sigma Black Belt, CMQ/OE, quality engineer, and software quality engineer.

Daniel is active in ASQ as an author and reviewer and as a member of multiple ASQ committees. He can be reached at daniel.zrymiak@accenture.com.



Name: Daniel John Zrymiak

Date of Birth: April 7, 1969

Residence: Surrey, British Columbia, Canada

Education: Bachelor of Commerce (Honors), multiple ASQ professional certificates

Current Job: Associate Manager, Technology

Previous Jobs: Software Quality Manager, Manufacturing Quality Manager, and various roles as Quality and Business Analyst within software and manufacturing

Introduction to Quality: ISO 9001 Management Representative for Panalpina Hong Kong, 1992

Favorite Definition of Quality: The aspirations, commitments, and techniques associated with planning, delivery, evaluation, and fulfillment of ideals, expectations, and tangible outcomes intended to serve the long-term, mutually beneficial interests of the organization, its participants, its customers and stakeholders, and society at large.

Major Contributions to the Field: Author, communicator, and instructor.

One Word Defining the Future of Quality: Adaptability

One Trend Defining the Future of Quality: Integration of Governance, Operational Excellence, and Management System commitments across all functional areas of an organization

Impact of Feigenbaum Medal: Basis of a long-term professional commitment to continue to advance and progress within quality and serve the profession along with members of this prestigious peer group. Very humble and overwhelming designation that places considerable expectations upon recipients to measure up and fulfill extraordinary expectations.

Favorite Book on Quality: Juran Quality Control Handbook, 4th Edition.

Three Publications: ASQ Six Sigma Green Belt Handbook, editions 1 and 2 (ASQ Press). Understanding Governance Within Organizational Excellence and Management Systems (ASQ Quality Management Forum, July 2015)

Plans for the Future: Continue to pursue quality opportunities within my current employer and clients, support ASQ member units as a member–leader, mentor, and support others within ASQ in their respective quality pursuits and journeys.

Quality Quote:

“Quality in a product or service is not what the supplier puts in. It is what the customer gets out and is willing to pay for. A product is not quality because it is hard to make and costs a lot of money, as manufacturers typically believe. This is incompetence. Customers pay only for what is of use to them and gives them value. Nothing else constitutes quality.”

Peter Drucker

Short Bio and Perspectives



Name: Chris FitzGibbon

Date of Birth: May 30, 1970

Residence: Ottawa, Ontario

Education: Masters of Management—Software Quality

Current Job: Consultant and Professional Auditor, Orion Canada Inc.

Previous Jobs: Software Tester, Software Project Manager, Quality Manager, Auditor

Introduction to Quality: As project manager, investigated how to improve on-time and on-budget deliveries.

Favorite Definition of Quality: Producing products and services that consistently satisfy customer and stakeholder requirements with maximum efficiency and minimal waste.

Major Contributions to the Field: Primary research on the impact of formal quality practices on software development project success. Book on ISO 9001 for small and medium-sized software organizations.

One Word Defining the Future of Quality: Dynamic

One Trend Defining the Future of Quality: A focus on measurable process efficiency.

Impact of Feigenbaum Medal: This recognition further inspired me to always give 100 % effort in all that I do.

Favorite Book on Quality: *Humphrey, Watts “Managing the Software Process” Addison-Wesley, 1989.*

Three Publications:

“Quality System Requirements for Medical Devices: Reference Guide for Manufacturers Selling Medical Devices in Europe, Canada and the United States” Industry Canada 2001, (with Joe FitzGibbon)

“ISO 9001 Registration for Small and Medium Sized Software Enterprises” Carleton/Oxford University Press 1995, ISBN 0-88629-255-7 (with A.J. Bailetti)

“ISO 9001 Registration: Lessons Learned by Canadian Software Companies” Fifth International Conference on Management of Technology, February 1996

Plans for the Future: To continue to grow my consulting business that helps motivated organizations improve their operational efficiency and implement management best practices.

Quality Quote:

A strong business case and measurable return on investment are essential to every successful quality system.

Short Bio and Perspectives



Name: Harriet B. Nembhard

Date of Birth: December 7, 1967

Residence: State College, Pennsylvania USA

Education:

- Ph.D., Industrial and Operations Engineering, University of Michigan, 1994
- M.S.E., Industrial and Operations Engineering, University of Michigan, 1993
- B.S.E., Industrial Engineering, Arizona State University, 1990
- B.A., Management, Claremont McKenna College, 1990

Current Job: Professor of Industrial Engineering at the Pennsylvania State University. He is also the director of the Center for Integrated Healthcare Delivery Systems as well as the Healthcare Quality and Systems Engineering laboratory. Additional academic responsibilities include leading to the Six Sigma Minor for undergraduate students in the College of Engineering and the Tracking and Evaluation Program for the Penn State Clinical and Translational Science Institute.

Previous Jobs: I have previously held academic positions at the University of Wisconsin–Madison, Auburn University, and École Centrale Paris (now CentraleSupélec).

Introduction to Quality: I began to understand the very real importance of quality on both safety and profitability during my first engineering summer internship at PepsiCo. The company's strong commitment to quality as a business driver led me to consider the degree to which it was present or absent in every organization I encountered thereafter. As my formal study of quality expanded through coursework in school, I gained a greater appreciation of the long history, fieldwork, and science needed to bring about quality. As we all know, quality is never an accident.

Favorite Definition of Quality: The first chapter of Douglas Montgomery's classic book, *Statistical Quality Control*, provides the following definition: Quality means fitness for use. I have considered many alternate definitions, but have thought none to be superior.

Major Contributions to the Field: I have done nothing by myself. It has been an honor and privilege to lead teams of outstanding students and colleagues. With these teams, I have published over 40 peer-reviewed journal papers and been the PI or co-PI on over \$2.5 million in research funding. The work has contributed both to fundamental knowledge and applications related to improve manufacturing and service systems. In particular, it has led to advances in the development of models and visualization methods for communicating healthcare data, development of a manufacturing process for small-scale medical devices, simulation models for assessing emergency department performance, modeling patient adherence to treatment, and quantifying research translation.

One Word Defining the Future of Quality: Resilient

One Trend Defining the Future of Quality: Efficiency has been one of the key tenants of quality and industrial engineering. Moving forward, quality will have to be maintained in an increasingly kinetic environment. Adaptable efficiency and resiliency will become more important modes of quality responses.

Impact of Feigenbaum Medal: The Feigenbaum Medal was, and continues to be, a recognition of my many roots to the quality academy.

Favorite Book on Quality: John Gardner's book entitled *Self-Renewal: The Individual and the Innovative Society* is one of the most impactful books I have read. Mr. Gardner masterfully investigates why some organizations—and the individuals who comprise them—atrophy and decay, while others remain innovative and creative. This is the pulse of the quality heartbeat. The problem is especially vital in the present kinetic era.

Three Publications:

1. Yuangyai, C., Nembhard, H. B., Hayes, G., Antolino, N., and Adair, J. H. (2009). “Yield Improvement for Lost Mould Rapid Infiltration Forming Process by a Multi-Stage Fractional Factorial Split Plot Design,” *International Journal of Nanomanufacturing*, 3, 4, 351–367.
2. Chen, S. and Nembhard, H. B. (2011). “A High-Dimensional Control Chart for Profile Monitoring,” *Quality and Reliability Engineering International*, 27, 4, 451–464.
3. Munoz, D., Nembhard, H. B. and Kraschnewski, J. (2014). “Quantifying Complexity in Translational Research: An Integrated Quality Function Deployment—Analytical Hierarchy Process Methodology,” *International Journal of Health Care Quality Assurance*, 27, 8, 760–776. DOI: <http://dx.doi.org/10.1108/IJHCQA-01-2014-0002>.

Plans for the Future: I am committed to healthcare quality and systems engineering. Infusing these ideas and aligning them with strategic and implementation plans to improve population health are key goals.

Quality Quote:

“Wake early, love boldly, learn continuously.”—Harriet B. Nembhard

Short Bio and Perspectives

Name: VIC NANDA

Date of Birth: Feb 25, 1972

Residence: ARIZONA, USA

Education: MS (COMPUTER SCIENCE), McGill University, Canada

BE (Computer Engineering), University of Pune, India

Current Job: Head Lean Six Sigma for Americas (Central functions) and Global Master Black Belt, Nokia

Previous Jobs: Corporate leadership positions in Quality Education and Learning Program management, deployment of quality management systems globally

based on industry quality frameworks such as ISO 9001, TL9000, CMMI, ITIL, and process improvement using Lean, Kaizen, and Six Sigma

Introduction to Quality: Mapping of complex globally distributed business process value streams for telecom systems design for Swedish telecom operator Ericsson

Favorite Definition of Quality: Quality is the measurement of process performance and capability against customer specifications (Six Sigma)

Major Contributions to the Field: Authored three books on quality, including the first book to explain ISO 9001:2000 requirements for the software industry (published by ASQ), a second cookbook for implementing a QMS from scratch (published by Taylor & Francis), and a third book that demystifies the use of Lean Six Sigma in the software industry—comprising best practices and success stories from the world’s top corporations that have effectively deployed Lean Six Sigma (published by McGraw Hill).

One Word Defining the Future of Quality: Monetization

One Trend Defining the Future of Quality: Business leaders want a *comprehensive* quality management system—not just to assure delivery to customer requirements, but including experts to guide and lead structured process improvement to improve quality and effectiveness, improve efficiency, improve sales growth, and drive innovation.

Impact of Feigenbaum Medal: Great motivator to contribute more to the profession, lead by example in my professional life, and strive to measure up to the expectations from medal winners.

Favorite Book on Quality: The Certified Manager of Quality/Organizational Excellence Handbook, Russ Westcott, ASQ.

Three Publications:

1. “Six Sigma Software Quality Improvement”, McGraw Hill, March 2011.
2. “Quality Management System Handbook for Product Development Companies”, CRC Press (Taylor & Francis), Jan 2005.
3. “ISO 9001:2000—Achieving Compliance & Continuous Improvement in Software Development Companies”, ASQ Quality Press, August 2003.

Note: This book was translated in Spanish by AENOR (Spanish Association for Standardization and Certification) in Jan, 2005. ISBN 84-8143-416-7.

Plans for the Future: Deepen my expertise in business and cost transformation using Lean concepts. Continuing to drive enhancements to Nokia’s continuous improvement methodologies for comprehensive alignment to business objectives, delivering a full suite solution.

Quality Quote:

Quality professional must pay their own paycheck.

To get and retain management attention, quality professionals must demonstrate impact of their work in terms of key process indicators, financial impact.

Short Bio and Perspectives



Name: Jeroen de Mast

Date of Birth: March 4, 1974

Residence: Amsterdam, The Netherlands

Education: Mathematics (MSc), Statistics (PhD)

Current Job: Professor of Methods and Statistics for Operations Management, Amsterdam Business School, University of Amsterdam

Previous Jobs: Principal consultant, Institute for Business and Industrial Statistics

Introduction to Quality: PhD thesis on the topic of *Quality Improvement from the Perspective of Statistical Method*.

Favorite Definition of Quality: Quality means delivering to the customer the right product or service

without errors. It is one of five performance dimensions of production and service processes (the other four being dependability, speed, flexibility, and cost).

Major Contributions to the Field:

1. Solid, scientific understanding of methods for problem solving and exploratory data analysis, and Six Sigma's DMAIC model in particular.
2. Scientific contributions to theory and methods for the statistical evaluation of measurement systems and (binary) tests.
3. Trained and coached hundreds of green belts, black belts, and master black belts in professional quality improvement.
4. Co-founder of the Dommel Valley Platform for design for Six Sigma and design for reliability.

One Word Defining the Future of Quality: Operations management

One Trend Defining the Future of Quality: Knowledge economy

Impact of Feigenbaum Medal: Recognition from one's colleagues is important and motivating. The Feigenbaum Medal acknowledges not only academic accomplishments, but especially real and tangible contributions to society. Such recognition, early in one's career, is a powerful stimulation.

Favorite Book on Quality: Juran JM (1989) *Juran on Leadership for Quality: An executive handbook*.

Three Publications:

Erdmann TP, Akkerhuis T, De Mast J, Steiner S (in press) "The statistical evaluation of a binary test based on combined samples" *Journal of Quality Technology*.

De Mast J (2013) "Diagnostic quality problem solving: A conceptual framework and six strategies" *Quality Management Journal* 20(4) 21–36 (2013).

De Mast J, Lokkerbol J (2012) "An Analysis of the Six Sigma DMAIC Method from the Perspective of Problem Solving" *International Journal of Production Economics* 139(2) 604–614.

Plans for the Future:

Further integrate theory from quality management in a course on operations management as it is typically taught in business schools.

Now, that there is a fairly long history of deployments of Six Sigma type improvement programs, apply case study research to obtain a solid understanding of the unfolding of such processes.

Continue fine-tuning quality improvement tools for the specific context of healthcare organizations.

Quality Quote:

In a knowledge economy, mastery of improvement and problem solving techniques is a vital skill for almost any professional.

Short Bio and Perspectives

Name: Gurpreet Singh

Date of Birth: 11/14/1978

Residence: 139 Sayre Drive, Princeton, NJ 08540

Education: PhD in Supply Chain Management (Expected 2018), MBA, Rutgers Business School, Rutgers State University, New Jersey
Bachelor of Technology, Guru Nanak Engineering College, India.

Current Job: Adjunct Professor at Rutgers Business School Rutgers University, NJ. Gurpreet teaches various MBA, MS, and executive MBA courses in the field of Lean Six Sigma and Supply Chain Management. He

shares his passion of education with other students through mentoring. He was appointed as an Industry Advisor to MBA students in 2014 and elected Rutgers University Senator in 2015.

President of Management Consulting Firm: Strategic Supply Chain and Six Sigma Consulting LLC. In this role, Gurpreet serves as a subject matter expert on various functions within Supply Chain Management, Lean Six Sigma, and Operational Excellence, and provides consulting services to public and private sector firms as well as public agencies. He also provides coaching and training in the field of Lean Six Sigma methodologies, Change Management, and Organizational redesign. He has trained over 1000 executives in Lean and Six Sigma methodologies and has assisted them with Lean Six Sigma certification.

Previous Jobs: Director of Process Improvement for a leading healthcare conglomerate in the US

Introduction to Quality: Have had a quality bent of mind from childhood, thanks to my dad who was also an engineer and believed in quality and instilled in me the value of quality. Later on, while pursuing my MBA interned under an ASQ Six Sigma Black Belt introduced me to the American Society for Quality in 2003.

Favorite Definition of Quality:

Major Contributions to the Field:

Gurpreet has led countless break-through Six Sigma projects in various sectors and especially in Healthcare and have a proven record of achieving considerable savings while streamlining the processes and focusing on change management while developing the people involved. He has developed a multifaceted focus on cost savings and process improvement by eliminating waste and has saved millions of dollars for his clients. He has a passion to share his knowledge with his students. Gurpreet is often invited to present seminars as a keynote speaker and has been invited to several conferences across the nation. He has also authored articles for several organizations.

Gurpreet has received several awards. For his efforts in the field of education, Gurpreet was honored with “ISM Education Person of the Year Award” in 2009 and with “Ray Clapton C.P.M. Award” in 2010. He was also honored with “ISM J. Terry Leadership Person of the Year” in 2014. Gurpreet Singh is an ASQ Certified Master Black Belt designated by American Society for Quality (ASQ), a distinction held by less than 100 people around the globe. He is also a designated Certified Purchasing Manger (C.P.M.), Certified Professional in Supply Management (CPSM), and a Certified Professional in Supplier Diversity (CPSD) having achieved all of these designations from Institute for Supply Management (ISM).

One Word Defining the Future of Quality: Inevitable

One Trend Defining the Future of Quality:

Vendors and buyers working together to focus on improving quality and processes. This is in contrast to the old approach where buying organizations will take a win-lose approach and push the vendors to reduce the price.

Impact of Feigenbaum Medal:

- It has increased my visibility across various networks and given me access to a lot of experienced and talented quality professionals across the globe. Further, I feel additional sense of responsibility in everything I do (personal or professional) and want to give 100 % to it.

Favorite Book on Quality: Juran’s Quality Handbook

Three Publications:

- Purchasing Success for the Service Sector: Using Lean 7 Six Sigma (2008)
- Achieving Operational Excellence in Service Sector using Lean Six Sigma Mindset (2011)
- Outcome of Lean Six Sigma tools in Healthcare Environment (In-progress)

Plans for the Future: Pursuing doctoral degree in Supply Chain Management and conducting research on impact of Lean Six Sigma on Healthcare and Hospital environments. Planning for transition into full-time tenure track teaching career in a leading university by 2018.

Quality Quote:

Quality is a necessity. The moment one realizes that it is a need and not a want, the mindset changes and the cycle of continuous improvement begins.