**2014.02.02.**

**Mieli KV magistrantai, absolventai ir visi KV svetainės skaitytojai,**

**pateikiame Jūsų dėmesiui kokybės guru T. N. GOH (Singapūro universitetas) dar nepublikuotą straipsnį *„Important Paradigm Shifts in Quality Management Practices”*, kurį autorius kilniai leido skelbti VU Kokybės vadybos magistro programos svetainėje (žr. susirašinėjimą žemiau):**

Dear TN,
1000 thank for your very quick work and very interesting article. This article, I hope, will be published in 2nd part of 2014.

**My question**:
**can you take your permission to place your article in the web-page of my QUALITY MANAGEMENT masters programme (**[**www.kv.ef.vu.lt**](http://www.kv.ef.vu.lt)**) just now, before this article will be published in the paper version of the scientific journal in Lithuania?**
The great Georgian thinker and poet Shota Rustaveli / Шота РУСТАВЕЛИ
tell that about 1000 years ago (my, JR translation):

“***Что Ты cпрятал, то пропало.  Что Ты отдал, то – Твое***” (Russian)
“***What you had hid – that is lost. What you had given – that is yours***” (English)
«***Ce que vous aviez caché  est perdu. Ce que vous aviez donné demeure en vous***» (French)
Quality Regards,
Juozas

"Goh Thong Ngee (ISE)" <[tng@nus.edu.sg](https://webmail.vu.lt/imp/dynamic.php?page=mailbox)> rašė:

Thank you, Juozas!  **It is my honour to have the article put on the Quality Masters programme web page: please go ahead!**
I wish you, your family and your colleagues all the best,

TN

Dear prof. TN,
**your response – is the the response of the GREAT man and of the GREAT QUALITYCIEN.**Many thanks/ Merci beaucoup,

Quality regards, Juozas (Lithuania)

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**Important Paradigm Shifts in Quality Management Practices**

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**Abstract**

This paper delineates some important paradigm shifts in quality management practices now and in the coming years. As a result of globalization and the distributed nature of conceptualization, design, development, marketing and after sales, regardless of whether the subject in question is a product or an instance of service, one has to have a broad view of the myriad of the factors that contribute to its competitiveness from a broad business point of view. In fact, rapid changes in technology, logistics, lifestyle, customer needs and demands together with increased business competitions will lead to even greater needs for system-level thinking and practice in quality management rather than the disjointed micro-management activities of the past. The challenges of “*Big Data*” are well known today, and their implications not just go beyond business interests but will be felt very strongly in technical fields as well. Thus quality management concepts and tools are in fact more dynamic than many had realized; this also means the quality profession has to continue to adopt new approaches and techniques if it aims to sustain a universal influence on business competitiveness.

**Key words**: quality management, performance improvement, organizational excellence, systems engineering, service quality, statistical thinking.

**1. Introduction**

Quality management is, ultimately, meant to serve the interests of customers. With rapid and accelerating changes surrounding the environment as well as needs and expectations of customers owing to the impacts of globalized economy, technology advances, demographic changes and so on, strategic perspectives and tools of quality management cannot remain static if performance is not to be affected by changes. This paper presents an overview of the paradigm shifts that have, or should have taken place since the days when quality management was regarded as a serious effort in modern industry about a century ago. Such changes should be taken seriously if the quality profession is to remain relevant to the competitiveness of organizations.

**2. Changing environment of quality management**

The conventional thinking is that quality management is central to organizational excellence: see, for example, Goetsch and Davis (2013). Typically, quality professionals acquired their knowledge via textbooks such as Grant and Leavenworth (1996) or Montgomery (2013) before encountering quality issues in the work place. While the study of classical works related to quality is important, practicing quality professionals and their managers would gradually lose their effectiveness if they are not aware of changes that are taking place in their operating environments. It is useful to examine the changing landscape in the quality world; the emphasis is on the slow but inexorable shifts in fundamentals rather than incremental changes and adjustments at the operations level. The target audience of the discussion would be business leaders and educationalists whose focus is on megatrends in this field rather than, say, details of data analysis techniques or specific requirements of quality standards.

It would be instructive to consider the difference between the paradigms of quality professionals today in contrast to that in the early twentieth century. Some major ones are listed below, followed by elaboration in more detail:

1. Unknown *vs* known customer identity;
2. Offers *vs* customer expectation;
3. Shifting of responsibilities in noise management;
4. Multi-dimensionality of quality: “Here”, “Now”, ”Unchanging”;
5. Transaction or service *vs* manufactured products;
6. Built-in *vs* controlled or improved quality;
7. Varied *vs* homogeneous market needs;
8. “Democratization” of statistics;
9. System *vs* local optimization;
10. Data abundance *vs* paucity.

**2.1. Unknown *vs* known customer identity**

The conventional overriding requirement for quality is “customer satisfaction”. This concept is basically concerned with the characteristics of a product at the time the product is acquired by the customer; little is considered about what happens subsequently. Taguchi’s “Loss to Society” concept (Taguchi, 1988) considers the customer in a much wider sense and from an opposite point of view: quality is an entitlement of the customer; when there is quality deficiency, then somewhere, somehow, some time, somebody in society is going to suffer; therefore quality concerns the society, not an individual. Such a viewpoint in fact is consistent with the Oriental concept of collective, rather than individual, welfare. With globalization, the concept of loss to society becomes even more obvious.

**2.2. Offers *vs* customer expectation**

Again, the conventional wisdom is that quality is realized when customer expectation is met or exceeded. However, customer expectations could vary according to the nature of offerings; thus Kano (1984) proposed the well-received Kano model for different types of quality, ranging from the basic to the delighting; this represents the beginning of the realization that quality is not based on attributes of universal values but is a function of customer expectations. However, even the concept of gauging quality levels by customer expectations was disrupted as new products are generated in a spirit best depicted by this quote by Steve Jobs ([Burlingham](http://www.inc.com/author/bo-burlingham) and [Gendron](http://www.inc.com/author/george-gendron), 1989): “You can't just ask customers what they want and then try to give that to them. By the time you get it built, they'll want something new.”

**2.3. Shifting responsibilities in noise management**

Another contribution of Taguchi to the field of quality is using statistical techniques – mostly based on Design of Experiments – to ward off the impact of noise on a product’s performance (Taguchi, 1988), later on popularly known as Robust Design Methodology (for example, Gremyr, 2005; Park and Antony, 2008; Bergman *et al*, 2009). Traditionally, the customer must make sure that the environmental stress on a product – caused by ambient temperature, humidity, vibration, etc. – as well as original variability in the properties of raw materials and parts, commonly known as noise, is kept low by observing the requirements set by the manufacturer of the product in question. However, with Robust Design the effect of noise on the variability of the product’s performance can be reduced, provided such design is executed as early as possible in the product realization process, before the manufacturing process begins. Such an approach is particularly relevant in the era of globalization where there noise control is difficult owing to the unpredictable and widespread locations for manufacturing, storage, shipping and marketing.

**2.4. Multidimensionality considerations**

Most learners of quality management are first informed of the multifaceted attributes of quality such as functions, costs, and esthetics, etc. leading to customer satisfaction (e.g. Geotsch and Davis, 2013). These quality characteristics are easily visualized with respect to products to be sold to identifiable customers at the time of transfer of ownership. However, multidimensionality takes on a different meaning with the growth of globalization: a product can be conceptualized, designed, manufactured, assembled, shipped and marketed at different locations on earth, with the possibility of multiple or changed locations for any of these processes. Thus quality cannot be managed on the basis of a given set of parameters reflecting a given time instant, given location, or given aspect of quality (as, for example, utility and esthetic values could be very different for different markets; a “chic” black dress in the West could be a bad omen in the East where red is a sign of good luck and prosperity). Added to this complexity is the time-dependent nature of processes; with the advent of Six Sigma for the concept of differentiating short-term and long-term performance was formally incorporated, signaling the role of the time dimension in quality considerations, not just in reliability studies.

**2.5. Transaction in addition to Manufacturing**

Courses and books in Quality comprise mostly techniques oriented towards manufacturing (see, for example, Grant and Leavenworth, 1996). Since “Six Sigma” as a quality management framework (Harry and Schroeder, 1999; Hahn, 2005) began to be adopted, and coincident with the increasing paid to service quality, quality of “transactions” or non-manufacturing processes and results have gained considerable attention. Further impetus was given by the ground-breaking work of Parasuraman *et al* (1985) and a quality professional today would be considered very poorly equipped if his thinking is totally based related to manufacturing does not possess a basic understanding of considerations related to quality of service.

**2.6. Built-in *vs* controlled quality**

The fact that the titles of most formal textbooks bear the word “control” (e.g. Grant and Leavenworth, 1966; Montgomery, 2013) reflect the mentality that activities related to quality are inherently prone to uncontrollable states. Indeed the emphasis on process capability studies and control charts, for example, presuppose that a process stands to suffer from adverse properties and hence close checks and monitoring are advisable, preferably with the backup of mathematically well-founded procedures. Indeed when Six Sigma was proposed, the unspoken tenet is still one of problem solving: see, for example, Goh (2002) and Hahn (2005). It was only after Six Sigma has taken off on a large scale that *built-in*, rather than *controlled*, quality was recognized as the overarching priority in any effort for performance excellence; thus concepts and procedures for Design for Six Sigma (DFSS) started to take root as detailed in Tennant (2-002), reflecting along with other tools such as Quality Function Deployment - for which a literature review is given by Chan and Wu (2002) - the obvious principle that “Prevention is better than cure”.

**2.7. Varied *vs* homogeneous market needs**

The importance of quality from the customer’s point of view has generally been well recognized in the literature, as in Juran and Godfrey (1999). However, the globalized economy has drastically changed what quality practitioners might appreciate as customer requirements. From the era of pre-globalization till today, the sea change is best put, in a very succinct way, by dotcom pioneer Joe Kraus (2013): "The 20th Century was about dozens of markets of millions of consumers. The 21st Century is about millions of markets of dozens of consumers". Thus the conventional idea of quality excellence being a state of total elimination of variation gradually takes a U-turn: it may not be the return of unwanted variation, but it certainly is recognition of the steadfast demand for more variety to suit the varied wants of customers in non-homogenous markets. In other words, while standardization and uniformity still have their place in quality management paradigm, true quality excellence and customer delight tomorrow needs to come from breakthroughs away from sameness and non-surprises - as Steve Jobs (1989) was reported to have said, “You can’t just ask customers what they want and then try to give that to them”.

**2.8. “Democratization” of statistical applications**

It has been well recognized that quality issues are caused by variation, and Statistics provides the most valuable tools for analyzing and managing variation – the case for Statistical Process Control is well known by all quality practitioners. However, for decades the acquisition and application of statistical knowledge have been hampered not only by the analytical theory, but also largely by the substantial data-crunching efforts needed for the application of statistical tools: one needs only take note of the use of range *R* instead of standard deviation *s* for the spread in the plotting of process control charts to realize what it takes to get around the challenges of computations, and the chore of manual calculation of sum of squares to understand why Analysis of Variance has not been as widely used as it should be. However, the wide prevalence of information technology hardware and software, meaning the notebook or tablet computers and user-friendly application software packages, has change the entire number-crunching landscape. There is no longer any excuse not to use statistical tools for quality improvement; the rapid adoption of Six Sigma, for instance, is in no small part due to this new statistical application environment (Goh, 2012). The result is what Hahn and Doganaksoy (2011) termed “Democratization of Statistics”; indeed the use of Statistical tools is now a “given”, well beyond the wildest dreams of “gurus” of the past such as, for example, Walter Shewhart or Edwards Deming (see Deming, 1986).

**2.9. System *vs* local management**

The tools leaned in school or on-the-job training are often rather specific in terms of coverage in time and space. Disjointed and micro-management techniques (e.g. Quality Function Deployment, Failure Modes and Effects Analysis, Acceptance Sampling Plans) are given as independent courses or modules of teaching and learning, with their integration left to the intelligence and needs of the practitioners. With the increasingly demanding levels of quality performance and complexity of situations to be dealt with, there have been stronger voices from advocates of quality management in terms of managing with perception of a larger picture. As pointed out before, the diversification of design, realization and marketing features of goods and services in a globalized element calls for an integrated view of the effectiveness of measures across various components of an overall system, be it a single corporation or a group of business units or companies. The systems approach to quality has been pointed out in some future studies, e.g. Conti *et al* (2003) has been well explained by Conti (2013).

**2.10. Abundance *vs* paucity of data**

A corollary of the use of Statistics for quality improvement is the availability of data. Where data is absent, for example in the study of new or unknown systems, techniques of data generation, collection and analysis, generally referred to as Design of Experiments, are needed (Box, 1999). However, with the availability of versatile sensors and efficient digital data gathering, storage and processing devices and systems, the statistical community is now confronted with what is generally referred to as the “Big Data” phenomenon – large volumes of raw data that become available at great velocity, volume, and variety. The challenge is still the same – extracting useful information for decision making, only the approach is from the other end, meaning that of abundance of data rather than paucity of data. The old adage of “In God we trust, others must bring data” probably has to be modified to “In God we trust, others must bring only relevant data”. This is a challenge hardly encountered by quality practitioners of the old days and, interesting enough, democratization of Statistics is poised to take a new turn because of the new challenges and responsibilities of the statistical work in decoding massive data for quality-related information.

**3. Conclusion: implications for the quality professionals**

Some people outside the quality profession hold the view that quality management can be encompassed in a definitive set of techniques much like what can be found in *Juran’s Quality Handbook* (Juran and Godfrey, 1999). Nothing can be further from the truth, as can be seen from the megatrends explained above. If one is to narrow down these further, then it can be said that the dual phenomena of *Globalization* and *Information Inundation* are the two pillars for further consequences such as service quality, market fragmentation, massive customization, new modes of data utilization, and magnified impacts of technology changes.

From now on, established quality management techniques and statistical tools such as those in conventional textbooks will be necessary but are by no means sufficient; thus “certified” quality engineers, managers or Six Sigma “belts” of the past can no longer be effective change agents for organizations hoping to stand out in an increasingly competitive, globalized, technology-intensive and data-rich environment. Such a dynamic, demanding prospect for the coming years makes this field exciting, indeed if the challenges are successfully handled and overcome, then quality management will take on a new important role never before experienced.

**REFERENCES**

Bergman, B.; deMaré, J.; Svensson, T.; Lorén, S. (eds) (2009). *Robust Design Methodology for Reliability*, Chichester, U.K.: Wiley.

Box, G. E. P. (1999). Statistics as a Catalyst to Learning by Scientific Method, *Journal of Quality Technology,* 31 (1), 16-29.

[Burlingham](http://www.inc.com/author/bo-burlingham), B.; [Gendron](http://www.inc.com/author/george-gendron), G. (1989). The Entrepreneur of the Decade. *Inc. magazine*, April, <http://www.inc.com/magazine/19890401/5602.html> on 31 January 2014.

Chan, L-K.; Wu, M-L. (2002). Quality function deployment: A literature review*. European Journal of Operational Research*, 143(3), 463-497.

Conti, T. (2013). How should quality-related concepts evolve to face the challenges of world globalization? *TQM Journal*, 25(6), 641-658.

Conti, T.; Kondo, Y.; Watson, H. (2003). *Quality into the 21st Century*. Milwaukee, WI: ASQ Quality Press.

Deming, W. E. (1986). *Out of the Crisis.* Cambridge, MA: MIT Center for Advanced Engineering Study.

Goetsch, D. L.; Davis, S. B. (2013). *Quality Management for Organizational Excellence*, 7th ed. Boston: Pearson.

Goh, T. N. (2002). A strategic assessment of Six Sigma. *Quality and Reliability Engineering International,* 18(5), 403-410.

Goh, T. N. (2010). Six Triumphs and Six Tragedies of Six Sigma, *Quality Engineering*, 22, 299 – 305

Grant, E. L.; Leavenworth, R.S. (1996). *Statistical Quality Control* (7th ed.). New York: Wiley

Gremyr, I. (2005). Exploring design for Six Sigma from the viewpoint of Robust Design Methodology. *International Journal of Six Sigma and Competitive Advantage,* 1(3), 295-306.

Hahn, G. J. (2005). Six Sigma: 20 key lessons learned: experience shows what works and does not work. *Quality and Reliability Engineering International,* 21(3), 225-233.

Hahn, G.J.; Doganaksoy, N. (2011). *A Career in Statistics: Beyond the Numbers.* Hoboken, NJ: Wiley.

Harry, M. J.; Schroeder, R. (1999). *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World’s Top Corporations*. New York: Doubleday.

Jobs, S. (1989). As reported in Interview, *Inc. magazine*, 1 April 1989.

Juran, J.M.; Godfrey, A.B. (1999). *Juran’s Quality Handbook* (5th ed). New York: McGraw-Hill.

Kano, N., Seraku, N., Takahashi, F. & Tsuji, S. (1984). Attractive quality and must-be quality (in Japanese). *Journal of the Japanese Society for Quality Control,* 14(2),39-48.

Kraus, J. (2013). Quoted in *BBC News Magazine* 11 October 2013: Imagine a world without shops or factories. <http://www.bbc.co.uk/news/magazine-23990211>, accessed 2 February 2014.

Montgomery, D. C. (2013). *Statistical Quality Control* (7th ed.). NY: Wiley.

Parasuraman, A., Zeitham, V.A., Berry, L.L. (1985). A Conceptual Model of Service Quality and Its Implications for Future Research," *Journal of Marketing,* 49(4), 41-50.

Park, S. H.; Antony, J. (2008)*. Robust Design fo Quality Engineering and Six Sigma*. Singapore: World Scientific.

Taguchi, G. (1988). *Introduction to Quality Engineering*. Tokyo: Asian Productivity Organization.

Tennant, G. (2002). *Design for Six Sigma*: *Launching New Products and Services without Failure*. Hampshire: Gower.