

Methodology Article

Six Sigma Hoax: The Way Professionals Deceive Science

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Abstract: Statistics is used in Physics (and in Nuclear Science as well): Six Sigma can be useful if properly applied; therefore scientists have to take into account the “correct” ideas. The document shows the ideas of the author to overcome the deep ignorance on Quality as it is found in many books dealing with Statistical Quality Control and Six Sigma. It is evident that there are many types of falseness provided by the “6 SigMONA practitioners”: they rob money from their clients that are not aware of that. When the 6σ BMWists say “A company’s performance is measured by the sigma level of their business processes” they lie: they do not know that, IF they compute s from the company’s data, they know the *estimate s* (NOT σ) AND s is never equal to σ ! The 1st falseness is the statement “variation is the enemy of Quality”. The 2nd falseness is the statement “variability reduction is Quality”. The 3rd falseness is the wide-spread use of the “Normal Distribution”. The 4th falseness is the statement “the number of defectives is 3.4 ppm”. The “6 SigMONA movement” does not deal properly with problem prevention, as on the contrary is done by GIQA. Scientificness is absent in the “6 SigMONA applications” as shown in the authors books.

Keywords: Six Sigma, Scientific Approach, Quality Education, Quality Methods, Rational Manager, Quality Tetralogy, Intellectual Honesty

1. Introduction: “The Problem Outline”

Six Sigma is very popular and hyped: it is considered the panacea of all the Disquality problems (Disquality=contrary of Quality). It became popular due to mainly the “advertising” of two important CEOs, Bob Galvin (Motorola’s CEO nearly the mid-1980s) and Jack Welch (General Electric): they did not know how far they were from Quality! [from 12 to 21]

Six Sigma can be useful if properly applied to Physics and in Nuclear Science as well: to do so scientists have to take into account the “correct” statistical ideas (see § 5).

We will see in this paper what Six Sigma is and why it is far from Quality! We call upon the Intelligence of the Readers and their Intellectual Honesty.

To show the 6σ (Six Sigma) drawbacks (when inappropriately used) we begin with the name: sigma, σ , is a letter in the Greek alphabet used in Probability Theory to measure the variability of a Random Variable (RV) and it is one of the *parameters* that characterise a *probability distribution*.

When data are collected for any phenomenon [e.g. in any process, as a physical experiment (to measure the

“god-particle” properties)] the parameter sigma, σ , is *estimated* by the collected data and the symbol “ s ” is used for the *estimate*; the *estimator S* [RV] has its own variability therefore s is never equal to σ ! [opposite to 12-21]

Consequently, when the 6σ BMWists [6 SigMONA] say “A company’s performance is measured by the sigma level of their business processes” they lie: they do not know that, IF they compute s from the company’s data, they know the *estimate s* (NOT σ)!

Moreover, when the 6σ BMWists say “The Six Sigma standard for the company’s performance is 3.4 problems per million opportunities...” they lie [12-21]: they do not know that, IF they compute s (which is named *statistic*) from the company’s data they know the estimate s (NOT $\sigma \neq s$) AND they do not know that 3.4 ppm is correct *ONLY IF* the phenomenon is *Normally distributed* with the *parameters* μ (the mean) and σ^2 (the variance) *both known*!

We will prove it. Reader be patient and confident. The truth will set you free!

MEDITATE. Reader, what has to do a serious scholar who knows the truth about a fact and he wants to say the truth in his documents? Has he to be a hypocrite and to pretend not to see

the errors, in order to be “politically correct”? IF a “professional” writes a wrong statement, the reader has two choices: either he believes to the error (and so he is cheated!), or he uses his own intelligence in order not to be cheated. Then can he say that the “professional” cheats his readers? We have two cases: (1) either the “professional” has scientific knowledge and knows that he is cheating people, (2) or the “professional” has NOT scientific knowledge and he is incompetent. In case (1) the “professional” lies! In case (2) the “professional” is incompetent!

Based on the very long experience of the author [from 32 to 110, § 5 a.-gg.] the present paper is offered to Managers, to Students (aiming at becoming Future Managers), to Young Researchers (aiming at becoming Scientific Researchers), to Scholars (aiming at learning Scientific ideas), and to Professors who want to learn the BASICS of Decisions based on the Scientific Analysis of problems and solutions in order to make Quality Decisions in their work of practical Research, Theoretical Research and Management.

It aims at showing in some detail the several aspects related to Management of Quality and Problems Solving, because only good methods are crucial for suitable decision taking (“Quality of methods for quality is important” as praised by J. Juran, at the 1989 EOQC Conference, Vienna) [48]. Decision-making is something which concerns everybody, both as maker of the decision (after either a serious or non-serious analysis) and as sufferer of the decision of other people (as well, after either a serious or non-serious analysis by them). Often we need data to decide: we analyse them to decide and we must take into account the consequences of our decisions; unfortunately always the data are affected by variability (they are uncertain to us) and therefore we need to consider uncertainties in detail and introduce them into the analysis for “*decision-making under uncertainty*”.

According to the consultant [notice!] Greg Brue (since 1994 President and CEO of *Six Sigma Consultants, Inc. and Senior Master Black Belt*) the Six Sigma story began in the 1980s at Motorola, when in 1983, the reliability engineer Bill Smith concluded that inspections and tests were not detecting all product defects, and decided that the best way to solve the problem of defects was to improve the processes to reduce or eliminate the possibility of defects in the first place. He set the standard of six sigma—nearly perfect, 99.9997%—and *coined the term Six Sigma* for the methodology. Another quality and reliability engineer at Motorola, Mikel Harry, further refined the methodology beyond eliminating process waste and *founded the Motorola Six Sigma Research Institute*. Question: did those two reliability engineers know Reliability Theory? NO! See the Theory in [100, 101, 103-106]

To date (March 2017), I met more than 50 Six Sigma “so

called” experts (are they?) who were and are completely ignorant about Quality and Reliability matters: in any case they have been *Certified Black Belts* and members of *Six Sigma Academies* (SSA).

Reader, since the beginning of his working life (1969) the author had the opportunity to meet many incompetents [see the documents from 32 to 110, § 5 a.-gg.]; only in 1995 he invented the Galetto Law: “*Quality decreases due to the increasing number of incompetents*” (figure 16). What has to do a serious scholar who knows the truth about a fact and that wants to say the truth in his documents? If he can prove that the “professionals” are incompetents even though they are “certified professionals”, why the serious scholar should not say the *this* truth?

2.6 Sigmona at Work

Incompetent and ignorant people, since 1990, have been robbing money to customers! They have been saying “Operating at Six Sigma creates an almost defect-free environment, allowing only 3.4 defects per one million opportunities: products and services are nearly perfect (99.9997%). “Six Sigma eliminates wasteful variation.”, attributing to W. Edwards Deming, the statement “Variation in any process is the enemy and it’s easier to fight an enemy you can see.” BMWists!!! This is false!!! [1, 2]

They do not know Deming’s ideas! He said «Uncontrolled variation is the enemy of quality.» and was referring to production processes of any item (also services) when using the Control Charts! [1, 2, 5, 6] Notice: Uncontrolled variation related to Control Charts, NOT to....

When teaching Quality ideas and considering 6σ (Six Sigma) Fausto Galetto used the statement «sei SigMONA» {which can be the Italian translation of “Big Six Sigma”, but actually it, in the Verona’s [the town of Romeo and Juliet] language means «you are (sei) Mister MONA (SigMONA)», where MONA stands for very stupid}: I will use the symbol either $6S$ or 6Σ . Let’s see why.

We saw before the genesis of $6S$ (Six Sigma) and of $6s$ (the estimate of Six Sigma); to remind the reader that, in the real world, you never can assess 6σ , I use $6S$ («sei SigMONA» for the incompetents who do not know the Theory and the Truth). They are the people who say “A basic principle of Six Sigma is reducing variation in the quality of outputs. To reduce it, we must be able to measure it.” Nobody can measure σ ; one can measure only s ! BUT, measuring the statistic s one does not measure Quality!

MEDITATE. SEE what “??professor??” D.C. Montgomery says about the definition of the word “Quality”; he says: “We prefer a modern definition of quality.

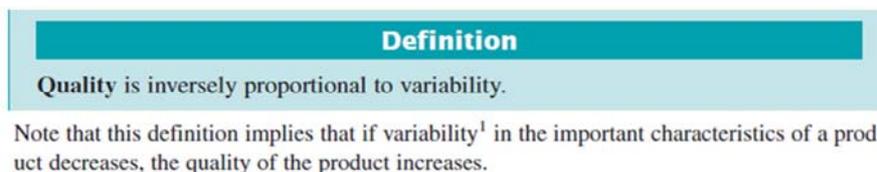


Figure 1. (definition, excerpt from Montgomery book 6th edition, in the Politecnico Library, commented by F. Galetto).

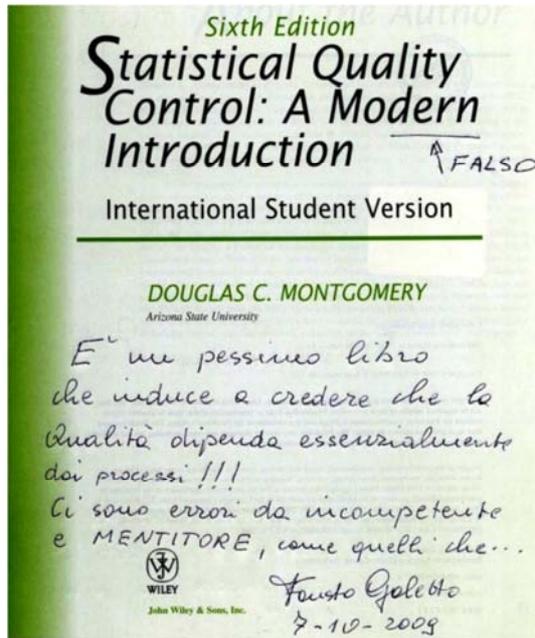


Figure 2. (front page from the 6th edition of the Montgomery book, found in the Politecnico Library, and commented by F. Galetto).

Quality [1-3, 5-6, 32-33, 36-38, 40-51, 58-59, 65-69, 71-79, 86, 88-95, 97-99, 100-108, 110, § 5 a.-gg.] is much more than “reduction of variability”. As a matter of fact, if a component has reliability given by the Weibull $R(t)$, it is clear to anybody that increasing the Mean Time To Failure of the component [we increase its “quality”] we increase ALSO the VARIANCE (variability!) of the component!, so DEcreasing its “quality” [according to Montgomery!]. IF the Mean Time To Failure, MTTF increases, hence the product has both better reliability, AND higher variance; therefore a product that fails less has, according to the incompetents, the “Montgomery quality WORSE!”. [7-11]

The Six Sigma fans follow the same stupid idea of the professor Montgomery!!! [12-21]

Montgomery [7-11] himself does not realize that he is in contradiction! How many students, all over the world, are learning wrong ideas due to incompetent professors, who suggest that very bad book to their students? [see figure 2]

The 6S movement is related to 4 types of Magic Falseness, as given in figure 3. We are going to analyse each one to let the reader appreciate how much 6S can be dangerous.

In the paper you find the «MEDITATE sections» formatted like the following where you see the “4 types of falseness” (see the list of books [12-28] we will consider to install the Galetto good ideas on which you have to think carefully: the reader must be SPQR «Semper Paratus ad Qualitatem et Rationem (“Always Ready for Quality and Rationality”)»):

MEDITATE. The 1st falseness is the statement “variation is the enemy of Quality”. People are surviving thanks to variation: only IF males and feminine generate sons without being strict relatives their sons probably do not have genetic illness; IF they were strict relatives their sons could have genetic illness due to “very similar” genetic code. Another

example: Science developed due to very clever researchers; IF all researchers were having the same “stupidity” we would not have any progress. The same for business. And Physics? IF there were no differences in atoms (bosons, leptons, quantum numbers, quarks) and molecules what would be the world? [statements about “stupidity” are given to show the danger of “no variation”].

The 2nd falseness is the statement “variability reduction is Quality”. People have different ideas: what about reducing the variability and have people all stupid? Would Quality increase? The reliability of a stand-by system (like the *main supply of electric energy* for a hospital plus an electric generator in case of failure of the *main supply*) is better than the single item reliability AND has MORE variability!!! What do you prefer: having or not having the electric generator in case of failure of the *main supply*???. 6S: please, answer!!!

The 3rd falseness is the wide-spread use of the “Normal Distribution”. Very many phenomena do not follow the Normal distribution. If X is a Random Variable and $F(X \leq x)$ is the probability of the event $[X \leq x]$, where x is a chosen real number; the Normal Distribution is given by the formula

$$\Phi(x; \mu, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} \int_{-\infty}^x \exp\left\{-\frac{1}{2}\left[\frac{t-\mu}{\sigma}\right]^2\right\} dt$$

where μ is a given or known number (named mean) and σ^2 is a given or known number (named variance); σ is the positive square root of σ^2 . The Normal Density is given by the derivative

$$\phi(x; \mu, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left\{-\frac{1}{2}\left[\frac{t-\mu}{\sigma}\right]^2\right\}$$

If LSL is the Lower Specification Limit= $\mu-3\sigma$ and USL is the Upper Specification Limit= $\mu+3\sigma$ the “good products” are 99.73% (see also the appendix).

Systems Reliability is never normally distributed!

Outside the interval $\mu-6\sigma$ – $\mu+6\sigma$ there are 0.002 ppm defectives. The rule of Six Sigma is to accept that the mean μ be far from the *Target T* as much as $\pm 1.5\sigma$; so doing there are 3.4 ppm defectives outside the interval $T-6\sigma$ – $T+6\sigma$.

The 4th falseness is the statement “the number of defectives is 3.4 ppm”. See the two “Remember” statements below and the integral

$$1 - \frac{1}{s\sqrt{2\pi}} \int_{LSL}^{USL} \exp\left\{-\left[\frac{t-m-1.5s}{2s}\right]^2\right\} dt - \frac{1}{s\sqrt{2\pi}} \int_{LSL}^{USL} \exp\left\{-\left[\frac{t-m+1.5s}{2s}\right]^2\right\} dt \gg 3.4 \text{ ppm}$$

We will prove that later! Moreover, let the reader suppose that we want to be “confident with 99.9 confidence level” that the *exponential* reliability of an item is $R(t) > 0.99999936$ [i.e. $< 3.4 \text{ ppm}$!!!] we must have 2.031.689 items that do not fail for 1000 hours!!! [i.e. 0.0000 experienced ppm!!!].

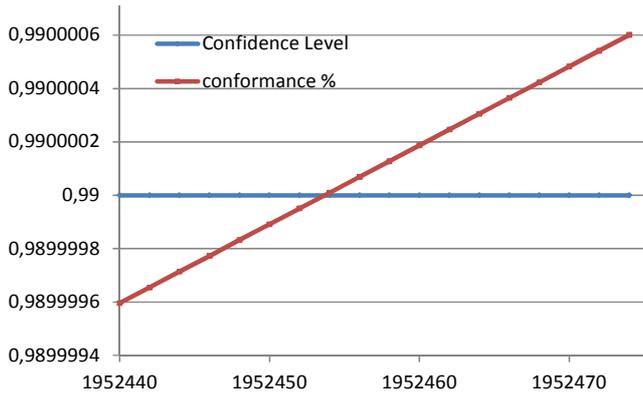


Figure 5. The number of measures for 3.4 ppm with CL=99%.

Therefore *Figure 3. The 4 types of Magic Falseness*»» is very important for the wise readers.

MEDITATE. Certainly it would be important for the following guy!!!! *He does not know the THEORY!!!* With other 2 incompetents is fellow of the SSIA, the 6σ Italian Association and so good to be the Director of the Master on 6σ!!! *HE knows and teaches wrong ideas. Nevertheless he is PhD, Visiting Prof. at MIT, author of 9 books, Master Black Belt, director of a Master on 6σ, Winner of the G. Taguchi Award on Robust Engineering.* Here is one excerpt from one of his books: I gave it to my students as a problem to be solved at their exams: *esercizio n. 12!!!!* (with two excerpts)

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Tabella 5.1 Esempio di dati rappresentabili con una distribuzione normale.

Macchina di prova	Tempo al guasto (ore)	Macchina di prova	Tempo al guasto (ore)
1	420	12	480
2	360	13	340
3	340	14	300
4	320	15	400
5	240	16	440
6	380	17	360
7	300	18	340
8	200	19	500
9	300	20	220
10	340	21	300
11	280	22	380

Molto istruttivo *relativo ad un libro sull'affidabilità di 3 bmwisti*. Analyse the previous data of reliability tests ...: three incompetent professors say, *proving their whole ignorance (they say that if some items do not fail by the end of the test the "suspended items" cannot be considered in the computations)*

vate al guasto dell'unità. Qualora alcune unità non arrivassero al guasto non è possibile considerare tale dato. Questo genera dei dati che non possono essere considerati ma che comunque generano dei costi di sperimentazione. *BMW ushi*

Suppose that the test is truncated at 400 h: estimate the MTTF, without neglecting the "suspended items". (the data are time to failure: data > 400 must be considered as non_failed at 400) *bmwisti means ...*

"can you be better than the great professorsssssss?"

Poor students cheated and deceived by the professors met and to be met! You are guilty, because you do not use your brain!!!!

Figure 6a. The incompetence of three BMWists (6 Sigmona).

YOUNG Researchers you MUST be ALERT if you want to LEARN: YOU MUST know the THEORY! ««The truth sets you free»»

Qualitatem

Intellectual hOnesty

DOCERE

Gedanken Experimente

Figure 6b. The warnig for reserachers with Q_IOGE (versus 6 Sigmona).

3. The "Magics" at Work

There are a magic number, 3.4 ppm, and a magic acronym DMAIC in the 6S movement... They are *both misleading!* Let's see why. The DMAIC is defined by different people with various different names: "the DMAIC methodology", "the

DMAIC framework", "the DMAIC model", "the DMAIC improvement model", "the DMAIC improvement methodology", "the DMAIC problem-solving methodology", "the DMAIC five steps of tactical Six Sigma", "the DMAIC process" you see here several excerpts from various books.

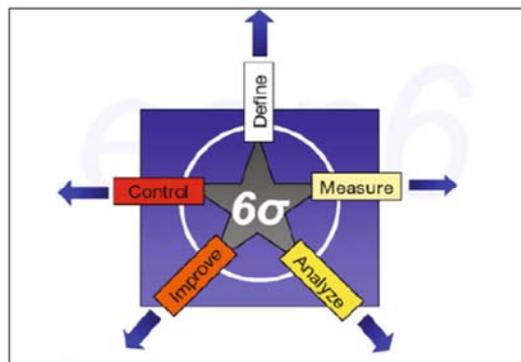


Figure 7a. DMAIC.

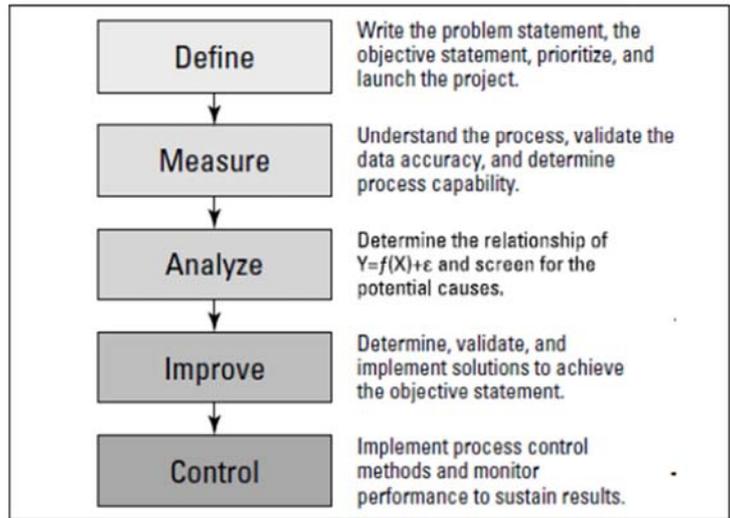


Figure 7b. DMAIC.

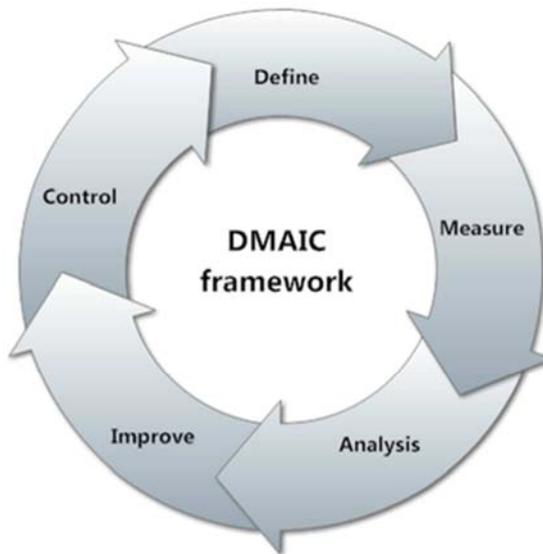


Figure 7c. DMAIC.

In all the cases the acronym DMAIC stands for Define, Measure, Analyse, Improve, Control. It is always referred to «processes»..., as though only processes matter for Quality. (!?!?) [figures from 7a to 7d]

NOTICE the following stupid 6S idea [figure 7d] (excerpt from an Italian book).

At the beginning in Motorola the acronym MAIC was used; General Electric and Allied Signal later used DMAIC, which is now the standard name.

Notice that DMA(g)IC is always related only to "deviations", "problems", "processes..."

It is wise to compare DMA(g)IC with the FAUSTA VIA (figure 8) of the Golden Integral Approach (GIQA), which consider both the products and the processes and begins with the Customers' Needs. [100, 101, 103-106]

The 6S practitioners say falsely that "DMAIC is the way for scientific decisions" because they claim that it is related either to Deming's PDCA or to Shewhart's PDSA.

<p>SCOPO DEL SIX SIGMA: Riduzione della variabilità</p>	<p>↔ ↔ Translation:</p>
	<p>The Goal of SIX SIGMA: Reduction of Variability</p>
	<p>↔</p> <p>See the car (and stand-by system) reliability!!!</p>

1. Define the problem.
2. Measure the problem (defects or deviation).
3. Analyze the root causes of the problem.
4. Improve the process (i.e., implement some countermeasures and verify results).
5. Control the process (i.e., measure and monitor to sustain the new level of improvement)

Figure 7d. DMAIC.

Compare the DMAIC [I prefer to name it DMA(g)IC, to remember the *magic* number 3.4 ppm!] with FAUSTA VIA that you see in the figure 8.

Only in FAUSTA VIA the Scientific approach is highlighted with the Theory figure, the PAC (Parent Adult Child) states (Eric Berne) and the needs of wise measurements (for decision-making). MEDITATE. There is the Reality (about a phenomenon) that it is generally hidden (in the clouds); we must find out what it is real: to do that, we need a Method beginning with Hypotheses, making deductions (to test our hypotheses) and designing experiments (to verify our deductions); through induction we then can identify the Theory which explains the phenomenon; to make a Theory we need data and therefore we must Decide "what, how, when, where" make measurements: we focus on the phenomenon and we asses where we stand; we must then understand scientifically and (scientifically) test the phenomenon; we

activate either the corrective or the preventive action; we verify their effectiveness, we implement them to assure Quality. To make *Quality first* any manager, decision-maker, researcher, scholar must Understand Scientifically and Test Scientifically his Hypotheses, before Activating any solution.

FAUSTA VIA is applicable both for Prevention (most important) and for Improvement!

The most NON-scientific idea of 6S(igMona) is the statement about the defectiveness "3.4 ppm attainable by processes using the DMA(g)IC, the way for scientific decisions".

This last statement is true only and only if normal distribution is actually applicable and if the actual values of μ , $\mu\Delta$, σ are known. The Six Sigma [6S(igMona)] BMWists never say that!!!! They lie!!! DMAIC is not scientific: Theory is disregarded.

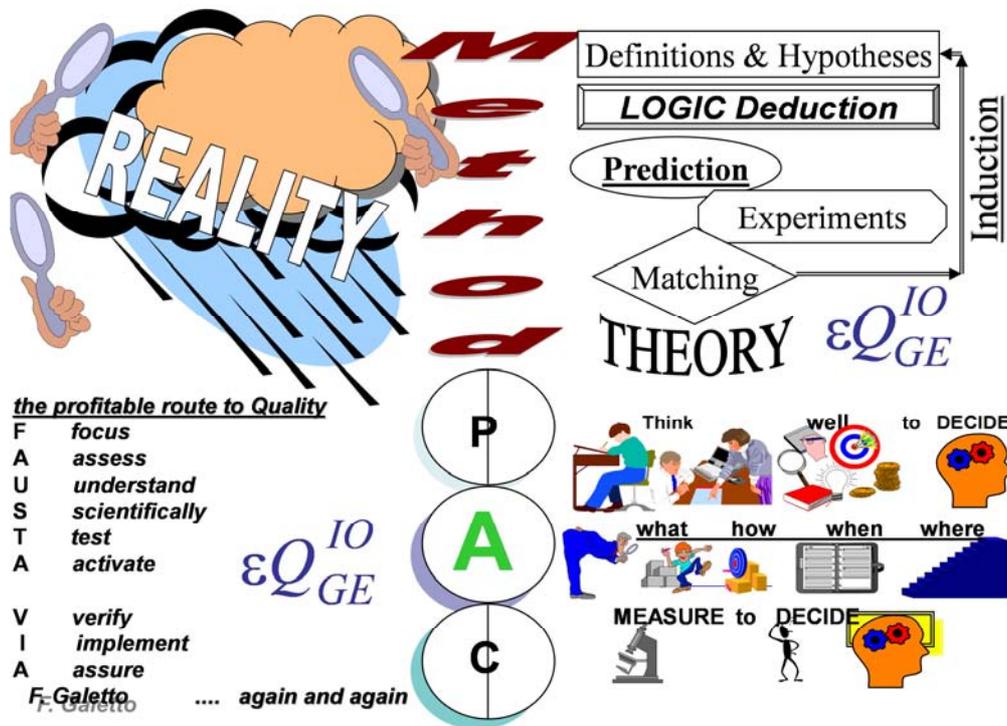


Figure 8. FAUSTA VIA with PAC and Theory.

MEDITATE. In the Measure step of the DMA(g)IC, you collect the data and in the Analyse step of the DMA(g)IC, you compute the defectiveness.

Since the data come out from the process NOBODY can know the actual values of the mean μ and of the variance σ^2 of the Normal Distribution: he can only estimate the parameters m and s^2 from their estimators $\hat{\mu}$ and $\hat{\sigma}^2$ [which are Random Variables!!!]; therefore nobody can say that the "Quality 0.99999966 is attained" BECAUSE the area.

$$\int_{\hat{\mu}-\lambda\hat{\sigma}^2}^{\hat{\mu}+\lambda\hat{\sigma}^2} f(t) dt$$

is a Random Variable and one can only state probabilistically, with risk α of being wrong, that the probability of "covering" the underlining distribution of the data is, at least $1-\alpha$ [the interval.

$$\hat{\mu} + \lambda \hat{\sigma}^2 \quad \text{---} \quad \hat{\mu} - \lambda \hat{\sigma}^2$$

is named "tolerance interval" (see the Appendix)

$$P \left[\int_{\hat{\mu}-\lambda\hat{\sigma}^2}^{\hat{\mu}+\lambda\hat{\sigma}^2} f(t) dt > 0.99999966 \right] = 1 - \alpha$$

All the 6S(igMona) BMWists are challenged to find only one 6S(igMona) Book saying this point.

The Six Sigma [6S(igMona)] BMWists never say that!!!! They deceive you and your intelligence!

Remember that the basics (wrong...!) of 6Σ [6S(igMona)] are:

- a) "variability is the number one enemy for quality",
- b) "a clear commitment to making decisions on the basis of verifiable data, rather than assumptions" and
- c) "any measurement in the quality field comes from a normal distribution", so that
- d) "using 6Σ you get only 3.4 defects per million".

MEDITATE. Reader, see the several wrong ideas of the following books from 12 to 29 [the first 3 authors are high level people in the SSIA: 6Σ [6S(igMONA)] Italian Academy], and papers; the «Taguchi S., Byrne D., 1986 *The Taguchi Approach to Parameter Design*, Best Technical Paper (!?), American Society for Quality Control» [29] cannot be dealt here; see [48-60, 100-108].

Remember that the «MEDITATE sections» are very important for Managers, Students, Scholars and Young Researchers who want NOT to be CHEATED by the many incompetents that they have (already) met and will meet in future, ONLY IF they WANT.

MEDITATE. The publishers community, often, act in such a way that "incompetent researchers are allowed to diffuse wrong ideas", while «competent researchers who find the diffused wrong ideas are NOT allowed to show them, UNLESS they pay "royalties to the incompetents"»!

In order to diffuse Quality Ideas on Quality and Methods, in 2015, I decided to pay for publishing a scientific book on Quality. In January 2017 I gave up the project because the publisher was interested more on typesetting rules than on the Quality of the content. There is NO science with that publisher that did not know what Science entails: they publish wrong papers and books. I informed them about that problem: they did not care!

The reader shall have to study Probability Theory and Statistics Theory in order to deal with uncertainty: chance is in our lives and we cannot act as if it were absent; we must be rational people!

Dear reader, I want to wish you the following [taken from the song «No llores por mi Argentina» ("Don't cry for me Argentina")]; there it is said «mi alma está contigo » that is (in my opinion and "translation") "my heart is with you"; I would like that you remember this, reader: when I speak about the incompetents who cheat you, "my heart is with you IXΣ", to help you not to be cheated.

The problem with the incompetents (see the *bibliography*) is the following: first, they do not care about Quality and all of them become allies against any person that shows their errors and provides the *scientific* way to overcome their errors; second, they refuse to acknowledge their own errors because they raised their career on them; third, they refuse to discuss with people proposing the *scientific* solutions of the errors and accept only the people who do not recognize their errors, thinking that "bibliometric indexes" (citations, impact factors, *h*-index, *s*-index, RG-index, very in fashion now!) is a proof of their value; finally, they are so many that the real scientists have little

chance to avoid their hidden weapons. (Fausto Galetto)

For example, you can see many citations, by Fausto Galetto, of D.C. Montgomery (due to his big errors); in the web I found him cited 22482+2578+10494 times; would that mean that he is a good divulger? Absolutely not!

I cited also many times other «well rated professors (e.g. QEG)» [30-31] Would that mean that they are good divulgers? Absolutely not!

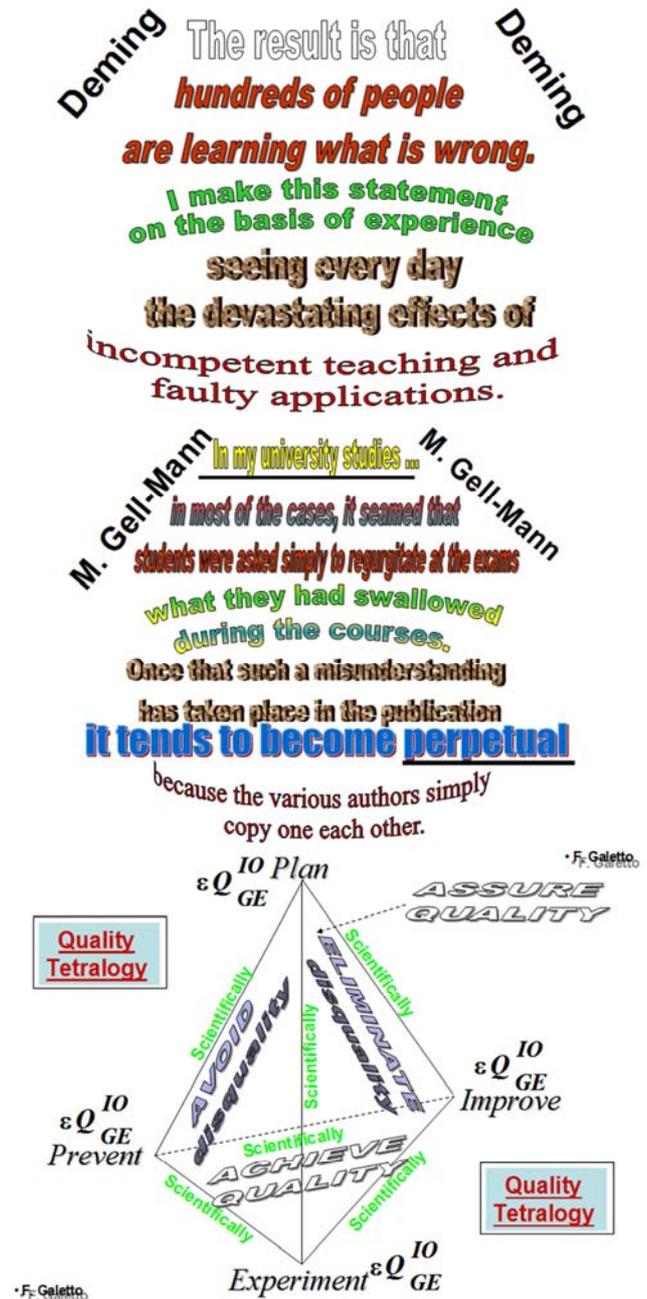


Figure 9. Statements from Deming, Gell-Mann, Galetto ideas.

PAY ATTENTION: I do not want to be offensive and I do not want to hurt anybody; IF I use «statements» such as "incompetents", "incompetent professors (authors)", I refer NOT to people BUT to their «proven incompetence, as shown

by Logic and Science» [36-59, 65-79, 88-95, 97-99, 100-108, 110, § 5 a.-gg.]. I cite those authors (professors) in order to let the Readers check what they say and see if I am right (Scientific) or not... I love QUALITY and I hate DISQUALITY.

To get sure results on Quality of Product, Processes and Systems, the company Management and workers must fulfil the FAUSTA VIA (fig. 8) and the Quality Tetralogy [avoid disquality (prevention of problems), eliminate disquality (correction of problems), achieve the Quality goals and assure the Quality achieved, through Planning, Preventing, Improving with Experiments Scientifically carried out]. (fig. 9) DMA(g)IC cannot do that! [48-60, 100-108].

Any Manager, Researcher and Scholar need data to take decisions, suitable to the case they have to solve. But it is not enough: anyone needs to analyse the data and transform them into VALID information. To get this he NEEDS methods: better it is if they are SCIENTIFIC. [36-59, 65-79, 88-95, 97-99, 100-108, 110 a-gg].

You can understand better if you see also the ideas of Fausto Galetto in the paper «*Management Versus Science: Peer-Reviewers do not Know the Subject They Have to Analyse.*», Journal of Investment and Management, Vol. 4, No. 6, 2015, pp. 319-329.

See figure 9.

To get sure results on Quality of Product, Processes and Systems, the company Management and workers must fulfil the FAUSTA VIA and the Quality Tetralogy [avoid disquality (prevention of problems), eliminate disquality (correction of problems), achieve the Quality goals and assure the Quality achieved, through Planning, Preventing, Improving with Experiments Scientifically carried out]. DMA(g)IC cannot do that! [48-60, 100-108].

In my working life as Scholar, Lecturer, Manager, Professor, ... I have been seeing a huge number of Lecturers, Managers, Professors, making wrong decisions BECAUSE they used wrong methods, NOT APPLICABLE to the problems they wanted to solve! [36-59, 65-79, 88-95, 97-99, 100-108, 110 a-gg]. This is my long experience in the Quality field, as teacher, Manager, professor, papers writer, ... When arguing on Scientific matters, everybody MUST act SCIENTIFICALLY.

6S BMWists do not act as they should do!

If the Peer-Reviewers had known the basics of probability they could have found the many errors, present in the published papers ... [36-79, 88-95, 97-99, 100-108, 110, § 5 a.-gg.].

Therefore we see that Managers, Researchers and Students must be alert and use the methods of Science (Logic, Mathematics, Physics, Probability, Statistics) in order to avoid to be cheated by incompetents. See all the figures.

In September 2015 the world experienced the very negative (Volkswagen) DIESEL-Gate, generated by the DIS-honesty of Volkswagen; 11 millions of cars were made and sold being defective (exhaust gases higher than allowed!!!): the Company cheated its Customers, so generating a huge amount of DISquality costs!!! Volkswagen was fined millions \$ by USA Ecology Authority.

The following statements of great scientists and managers

are important for any person who wants to make QUALITY Decisions on QUALITY matters.

We think that the YOUNG Researchers MUST be ALERT if they want to LEARN: THEY MUST know the THEORY! [36-59, 65-79, 88-95, 97-99, 100-108, 110, § 5 a.-gg.].

The author Galetto always invited people to be intellectually honest in teaching and taking decisions: THEORY is fundamental in both cases. [see the F. Galetto documents, in the references, in the RG database, and in his books]. From above we see that Fausto Galetto taking into account the following statements by great people, as always did, could provide a sensible advice for any Researcher, in any university, and any Manager, in any Company.

W. E. DEMING "It is a hazard to copy". "It is necessary to understand the theory of what one wishes to do or to make." "Without theory, experience has no meaning." "A figure without a theory tells nothing". «The result is that hundreds of people are learning what is wrong. I make this statement on the basis of experience, seeing every day the devastating effects of incompetent teaching and faulty applications.»

M. GELL-MANN "In my university studies ..., in most of the cases, it seemed that students were asked simply to regurgitate at the exams what they had swallowed during the courses.". Some of those students later could have become researchers and then professors, writing "A_scientific" papers and books ... For these last, another statement of the Nobel Prize M. Gell-Mann is relevant: «"Once that such a misunderstanding has taken place in the publication, it tends to become perpetual, because the various authors simply copy one each other."»», similar to "Imitatores, servum pecus" [Horatius, 18 B.C.] and "Gravior et validior est decem virorum bonorum sententia quam totius multitudinis imperitiae" [Cicero].

P. B. CROSBY Paraphrasing P. B. CROSBY one could say "Professors may or may not realize what has to be done to achieve quality. Or worse, they may feel, mistakenly, that they do understand what has to be done. Those types can cause the most harm."

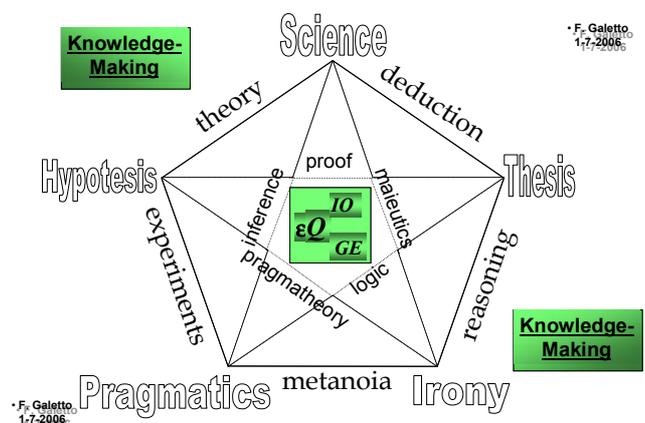


Figure 10. Quality Tools and Quality Methods: avoid the Disquality.

What do have in common Crosby, Deming and Gell-Mann statements? The fact that professors and students betray an important characteristic of human beings: rationality [the

“Adult state” of E. Berne]

A. EINSTEIN "Only two things are infinite: the Universe and the Stupidity of people; and I'm not sure about the former".

GALILEO GALILEI Before EINSTEIN, GALILEO GALILEI had said [in the Saggiatore] something similar "Infinite is the mob of fools".

The scientific community as a whole must judge [κρίνω] the work of its members by the objectivity and the rigor with which that work has been conducted; in this way the scientific method should prevail. Any professor and any Statistical Consultant should know Probability Theory and Statistics!

I always was used to say to my students: «If a guy suggests books and papers written by incompetents he is TWICE incompetent, because he does not recognize wrong ideas and suggests to read wrong ideas» [36-59, 65-79, 88-95, 97-99, 100-108, 110 a-gg].

Unfortunately several Professors do not practice the two important methods used here, the Logic and the Scientific Theory (Mathematics, Probability, Statistics, Physics). See the references.

Please see well the figures and see IF ...

Researchers shall use their intelligence in order to make knowledge for the improvement of people and their life.

Researchers MUST not cheat people and act according to the figures 9 and 10.

Any Intellectually hOonest person that loves QUALITY and hates DISquality will Focus on the problems [potential and/or actual], Assess their importance (money, impact, consequences, risks), Understand all the previous items SCIENTIFICALLY and SCIENTIFICALLY Test for finding the causes; when a solution is found anybody will Activate to implement the solution, in order to Guaranty that Reliable Actions (preventive and corrective) are taken Through an Intelligent Approach (approach that uses intelligence, ingenuity and science, avoiding misdeeds). [FAUSTA GRATIA is a modification of FAUSTA VIA]. [§ 5 gg.]

This is very much better than the 6σ [6S(igMONA)] *problem-solving method*. See the case presented in the section 4 (related to the way a 6σ [6S(igMONA)] BMWist author solved a Design Of Experiment (DOE) application: actually he copied wrongly a case from the paper «Taguchi S., Byrne D., 1986 *The Taguchi Approach to Parameter Design*, Best Technical Paper (!?), American Society for Quality Control» is dealt in § 4.

Volkswagen did not use the FAUSTA GRATIA to avoid of DISquality!!!! Volkswagen betrayed the «epsilon Quality» to avoid of DISquality!!!! Volkswagen did not consider the *Decision-Making Tetrahedron* to avoid of DISquality!!!! Volkswagen sold DISquality (!!!!) with DIShonesty!!!!

Eric Berne devised the Transactional Analysis “Theory” [that actually is not a theory in the scientific sense] with the 3 EGO_States: Parent, Adult, Child.

The Parent ego_state is a set of thoughts, feelings, and behaviours that are learned or “borrowed” from our parents or other caretakers. Two parts are comprised: the Nurturing Parent ego_state soft, loving, and permission giving, and

Prejudiced Parent, the part of our personality that contains the prejudged thoughts, feelings, and beliefs that we learned from our parents.

The Adult ego_state is our data processing centre. It is the part of our personality that formulate hypotheses to be verified by experiments, uses LOGIC and SCIENCE, invents METHODS to test ideas and to process data accurately, that sees, hears, thinks, and can come up with solutions to problems [potential and/or actual] based on the facts and not solely on our pre-judged thoughts or childlike emotions: it denounces misdeeds. Qualitatis FAUSTA GRATIA is related to the Adult ego_state.

The Child ego_state is the part of our personality that is the seat of emotions, thoughts, and feelings and all of the feeling state “memories” that we have of ourselves from childhood. The Child ego_state can also be divided into two parts: the Free Child ego_substate is the seat of spontaneous feeling and behaviour. It is the side of us that experiences the world in a direct and immediate way. Our Free Child ego_substate can be playful, authentic, expressive, and emotional, and the Adapted Child ego_substate that is the part of our personality that has learned to comply with the parental messages (from everywhere and everybody) we received growing up; if we are faced with parental messages (from everywhere and everybody) that are restricting, instead of complying with them, we rebel against them.



Figure 11. The epsilon-Quality to avoid the Disquality.

The Adult ego_state is embodied in the ϵQ_{GE}^{IO} symbol (the epsilon-Quality).

Intellectually hOonest people use as much as possible their rationality and Logic, in order not to deceive other people.

Deming, Einstein, Gell-Mann are beacons for the Quality Journey.

If we want to achieve QUALITY, MANAGERS (now students) NEED TO BE EDUCATED ON QUALITY ϵQ_{GE}^{IO} by Quality Professors, EDUCATED on Quality. [36-59, 65-79, 88-95, 97-99, 100-108, 110, § 5 a-gg].

I could, at last, paraphrase ST John “And there are also many other things, the which, if they should be written everyone, I suppose that even the world itself could not contain the books that should be written.”

Will someone want to see the truth? Only God knows that.

The personal hints are left to the Intellectually Honest

reader to whom is offered the Quality Tetralogy: Prevent, Experiment, Improve, Plan, SCIENTIFICALLY to avoid disquality, to eliminate disquality, to achieve Quality, to assure Quality, using Intellectual Honesty: we wish them to use correctly the Decision-Making Tetrahedron.

Quality Tetralogy and Decision-Making are much better than ISO 9004:2008 (and 2015, as well) and 6S(igMona) because Quality Tetralogy and Decision-Making Tetrahedron take into account explicitly the need for scientific behaviour either of people or of organizations that really want to make Quality. Moreover they show clearly that prevention is very important for Quality and Good Management is strongly related to Good Knowledge for Business Excellence.

Reliability (a very important dimension of Quality, figure 13) cannot be achieved if Management do not practice the Quality Tetralogy, the Decision-Making Tetrahedron, the FAUSTA GRATIA and the Scientific Approach.

You will see, in [36-59, 65-79, 88-95, 97-99, 100-108, 110 a-gg] a lot of Methods found through the Scientific Approach.

Brain is the most important asset: let's not forget it, IF we want that our students (Future Managers or Future Researchers) be better than their professors.

We repeat

YOUNG Researchers MUST be ALERT

if they want to LEARN:

THEY MUST know the THEORY!

««The truth sets you free»»

Professors, scholars and researchers WHO DO NOT ARE Intellectually hOnest will not grow students and researchers fond of Quality (see figures).

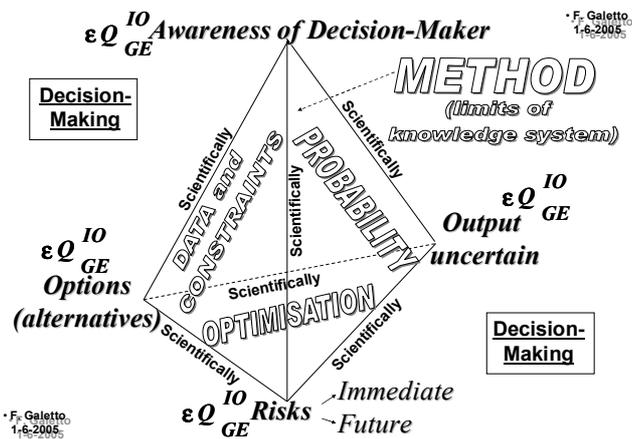


Figure 12. The Decision-Making Tetrahedron.

The documentation is related to the author's books and papers, where one can find many cases taken from the managerial experience of FG, practised in first class Corporations (and in many scientific courses, at University): Three Galetto's books have shown many cases, that cannot be dealt with DMA(g)IC:

1. Reliability and Maintenance, Scientific Methods, Practical Approach, Volume ONE, published by

SCHOLARS' PRESS (2016).

2. Reliability and Maintenance, Scientific Methods, Practical Approach, Volume TWO, published by SCHOLARS' PRESS (2016).

3. Design Of Experiments, Theory and Practice, published by SCHOLARS' PRESS (2016).

The concepts given here originated from the experience of the author (more than 45 years) in the Quality field, both as Manager [CGE, SIT-Siemens, FIAT Auto, Philco Italiana, IVECO], as consultant and as lecturer {at Universities [Università di Padova, Università di Genova, Politecnico di Torino (Torino, Vercelli, Alessandria), Università di Modena e Reggio], and in many courses for AICQ, COREP, Qualital)}, and for Corporations. [36-59, 65-79, 88-95, 97-99, 100-108, 110 a-gg].

The documentation has been developed in cooperation with QuASAR ϵQ_{GE}^o , a Management Consultant Company [Società di Consulenza Manageriale sulla Qualità (Via A. Moro 8, 20090 Buccinasco, Milano)].

Several times Fausto Galetto will make reference to one of the greatest scholars in the Quality field, W. E. Deming.

I will cite some of his statements, taken from his book (hoping that the readers find him as an example!).

The incompetents go on with their errors and make a lot of damage.

The F. Galetto's books [65, 103-108] are important because they show various problems that require the use of the reader (YOU) intelligence, in order that he is not cheated.

See there.

Compare the 6 SigMONA "quality definition" and the one given in the Quality Tetrahedron. To intelligent person is evident that the 6 SigMONA hyped movement missed many important ideas for making Quality the first time!

The Quality Tetrahedron shows that management must learn that solving problems is essential but it is not enough: they must prevent future problems and take preventive actions (figure 14). As said before, PDCA is useless for prevention — it is very useful for improvement.

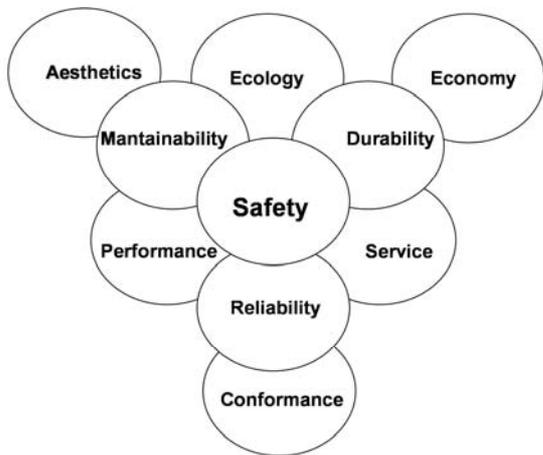
Several of the quality characteristics (in the quality tetrahedron, figure 13) need prevention. Reliability is one of the most important: very rarely can failures be attributed to blue-collar workers. Failures arise from lack of prevention, and prevention is a fundamental aspect and responsibility of management. The same happens for safety, durability, maintainability, ecology, economy, etc. Let us think of the failures of the Shuttle and of the Russian satellite MIR (April 1997). Also the "ecological disasters" were generated by lack of Quality Management and lack of "Quality Understanding". We are in a new economic age: long-term thinking, prevention, quality built in at the design stage, understanding variation, waste elimination, knowledge and scientific approach are concepts absolutely necessary for management.

Notice that the «INTERNATIONAL STANDARD ISO 9001 Fifth edition 2015-09-15, Quality management systems — Requirements (Systèmes de management de la qualité — Exigences)» still lacks the correct concept about PREVENTION. As a matter of fact, the Standard states

[please read carefully]

«Risk-based thinking (see Clause A.4) is essential for achieving an effective quality management system. The concept of risk-based thinking has been implicit in previous editions of this International Standard including, for example, carrying out preventive action to eliminate potential nonconformities, analysing any nonconformities that do occur, and taking action to prevent recurrence that is appropriate for the effects of the nonconformity.

To conform to the requirements of this International Standard, an organization needs to plan and implement actions to address risks and opportunities. Addressing both risks and opportunities establishes a basis for increasing the effectiveness of the quality management system, achieving improved results and preventing negative effects.»



• F. Galetto

Quality Tetrahedron

Figure 13. The Quality Tetrahedron for the Quality definition.

The essence of Quality is PREVENTION.

The standard, again (as it was previously) confounds planning with prevention!

Table 1. Data of the Best Technical Paper (!?).

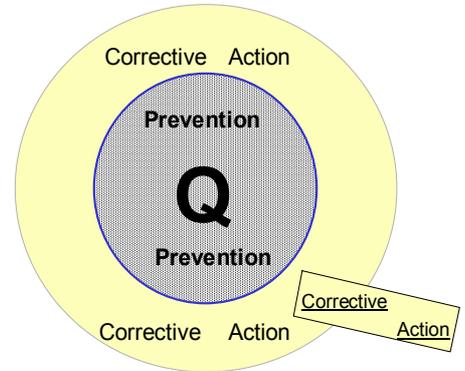
Outer Array	Inner Array				E, F, G "outer factors"								
					response				S/N				
	A	B	C	D									
		E	1	1	1	1	-1	-1	-1	-1			
		F	1	1	-1	-1	1	1	-1	-1			
		G	-1	1	-1	1	-1	1	-1	1			
	-1	-1	-1	-1	19.1	24.025	19.6	19.6	19.9	16.9	9.5	15.6	24.025
	-1	0	0	0	21.9	25.522	19.8	19.7	19.6	19.4	16.2	15.0	25.522
	-1	1	1	1	20.4	25.335	18.2	22.6	15.6	19.1	16.7	16.3	25.335
	0	-1	0	1	24.7	25.904	18.9	21.0	18.6	18.9	17.4	18.3	25.904
	0	0	1	-1	25.3	26.908	21.4	25.6	25.1	19.4	18.6	19.7	26.908
	0	1	-1	0	24.7	25.326	19.6	14.7	19.8	20.0	16.3	16.2	25.326
	1	-1	1	0	21.6	25.711	18.6	16.8	23.6	18.4	19.1	16.4	25.711
	1	0	-1	1	24.2	24.832	19.6	17.8	16.8	15.1	15.6	14.2	24.832
	1	1	0	-1	28.6	26.152	22.7	23.1	17.3	19.3	19.9	16.1	26.152

NOTICE: the columns N1 and N2 of the Excerpt 4; compare them with the 7th and the 2nd columns (of the response, "italicised", where the datum 16.7 became 6.7) of the table of the "best technical paper" of Byrne-Taguchi.

See the Quality Tetralogy: Prevention avoids disquality (before it can happen) and achieve Quality, while Improvement eliminates disquality (after it happened): both have to be carried out Scientifically. Where is all that in the ISO Standard?

The same problem is related to the 6Σ/[6S(igMona)]!

ϵQ_{GE}^{IO}



Quality Essence (the core is Prevention)

• F. Galetto

Figure 14. The essence of Quality: the PREVENTION.

4. 6Σ [6S(igMONA)] and Taguchi Methods Versus GIQA

We see in this section an application found in a 6Σ [6S(igMona)] book (in the references).

See the following table with the data of the paper *The Taguchi Approach to Parameter Design*, Best Technical Paper (!?), American Society for Quality Control («Taguchi S., Byrne D., 1986») [29].

Example 14.6. Maximize Pulloff Force for an Elastometric Connector to a Nylon Tube This Taguchi parameter design project involves finding the optimal process parameters in assembling an elastometric connector to a nylon tube in an automobile engine application. It is required that the strength of the connection be strong. The quality characteristic measured in this project is the pulloff force, which is a larger-the-better characteristic.

There are four control factors in this experiment:

Control factors	Level 1	Level 2	Level 3
A Interference	Low	Medium	High
B Connector wall thickness	Thin	Medium	Thick
C Insertion depth	Shallow	Medium	Deep
D Percent adhesive in connector prepip	Low	Medium	High

There are three noise factors as follows:

Noise factors	Level 1	Level 2
U Conditioning time, h	24	120
V Conditioning temperature, °F	72	150
W Conditioning relative humidity, %	25	75

Experiment no.	Control factors				Pulloff force measured at compounded noise levels		\bar{y}	S/N η
	A	B	C	D	N1	N2		
1	1	1	1	1	9.5	20.0	14.75	21.68
2	1	2	2	2	16.2	24.2	20.20	25.59
3	1	3	3	3	6.7	23.3	20.00	25.66
4	2	1	2	3	17.4	23.2	20.30	25.88
5	2	2	3	1	18.6	27.5	23.05	26.76
6	2	3	1	2	16.3	22.5	19.40	25.42
7	3	1	3	2	19.1	24.3	21.70	26.54
8	3	2	1	3	15.6	23.2	19.40	25.25
9	3	3	2	1	19.9	22.6	21.25	26.49

where the signal-to-noise ratio is computed by using the formula for the larger-the-better quality characteristic:

$$S/N = -10 \log\left(\frac{1}{n} \sum_{i=1}^n \frac{1}{y_i^2}\right)$$

Analysis of Variance for S/N, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
A	2	6.1128	6.1128	3.0564	**	
B	2	2.7057	2.7057	1.3528	**	
C	2	8.4751	8.4751	4.2376	**	
D	2	1.2080	1.2080	0.6040	**	
Error	0	0.0000	0.0000	0.0000		
Total	8	18.5016				

SEE the 6σ [6S(igMona)] BMWist Author conclusions....

Clearly, *C* is the most important factor; *A* and *B* also have significant effects on S/N.

From the main-effects chart on S/N (Fig. 14.22), we can see that *C* and *A* should be set at level 3 and *B* should be set at level 2.

The predicted signal-to-noise ratio at the factor level combination given above is

$$S/N = A_3 + C_3 + B_2 - 2T = 26.10 + 26.32 + 25.87 - 2 \times 25.48 = 27.33$$

The predicted mean pulloff force is $A_3 + C_3 + B_2 - 2T = 20.78 + 21.58 + 20.88 - 2 \times 20.0 = 23.24$.

Figure 15. Excerpt from a 6σ [6S(igMona)] book.

Since there are 72 data (in table 1), you can know better your process by analysing the significance of interactions, if the original data, not the S/N, are processed: the significant interactions between the "controlled factors" are highlighted in the next table ("bolded capital letters") and the significant interactions between the "controlled factors and the noise factors" are highlighted in the table ("italic bold capital letters"); moreover "noise factors" are more significant than controlled factors.

Table 2. ANOVA of F. Galetto on the data of the Best Technical Paper (!?).

source	df	SS	MS	Fc	F5%	sig
A	2	50.58	25.29	8.21	6.94	*
B	2	13.38	6.69	2.17	6.94	
C	2	68.59	34.30	11.14	6.94	*
D	2	23.67	11.84	3.84	6.94	
A*B	4	92.27	23.07	7.49	6.39	*
A*C	4	37.06	9.26	3.01	6.39	
A*D	4	81.97	20.49	6.66	6.39	*
B*C	4	74.25	18.56	6.03	6.39	
B*D	4	119.2	29.79	9.67	6.39	*
C*D	4	63.96	15.99	5.19	6.39	
E	1	275.7	275.7	89.5	7.71	*
F	1	161.7	161.7	52.5	7.71	*
A*G	2	68.99	34.49	16.16	6.94	*
D*E	2	222.0	111.0	52.0	6.94	*
D*F	2	141.8	70.89	33.21	6.94	*
D*G	2	29.62	14.81	6.94	6.94	
Residual	4	8.54	2.135			

The so called "product array design" structure (product of the inner by the outer array) led to a very large experiment of 72 test states that did not permitted the estimation of the interactions (so the authors were forced to neglect them!!). *If they had used the G-method they could have designed a "combined array" of the "structural factors" that would have been more likely to improve process understanding and*

$$(A+B) @ C*D @ (A+C) @ B*D @ (A+D) @ B*C @$$

This means that changing "additively" any two factors is exactly the same as changing "interactively" the other two factors and.... As a consequence you cannot choose the best levels of factors as though they were independent, "a magic

decisions. Moreover they could have made a better analysis of the data, as done by F. Galetto (see table 2).

A simpler analysis (with similar information on the significance of factors and interactions) was done [using a pocket computing machine] immediately after the Marentino conference (Fiat Group, 1985) and sent to all the manager; the outcome of that was a very fast application of Taguchi Method at FIAT-Auto, the car factory: managers are not able to take Logic Quality Decisions, and therefore they waste money!!!

The residual error is not computed as difference of the estimated factors and interactions from the corrected total sum of squares SS, in the ANOVA table. *But there is an important hoax always hidden by Taguchi and his lovers.* When you carry out a part of all the test you should do (the "fractional replication design") you can NOT obtain the same information of the complete design: you cannot separate factors effect and interactions effects: they are inevitably entangled.

The experimental "inner array" is a "fractional factorial 3^{4-2} design" in the controlled factors A, B, C, D. There are several ways to get it (see Galetto's books).

The authors (Taguchi S., Byrne D.) did not provide the "alias structure", as always do the "Taguchi lovers". If they had used the G-method they would have found that every factor is "entangled" with various interactions (we use the symbol & for the "entanglement relation" and... for not shown higher order interactions) [48, 100-108, 110, § 5 a.-gg.]:

$$A \& B * C \& B * D \& C * D \& ABC \&; \quad B \& A * C \& A * D \& C * D \&; \\ C \& A * B \& A * D \& B * D \&; \quad D \& A * B \& A * C \& B * C \&.$$

"Entanglement" is an "equivalence relation", in a logical sense. More precisely, there is also the ALIAS structure (the symbol @ stands for "equivalent to"), neglected by Byrne and Taguchi [48, 100-108, 110, § 5 a.-gg.]:

$$(B+C) @ A * D @ \quad (B+D) @ A * C @ \quad (C+D) @ A * B @$$

feature of Taguchi orthogonal arrays".

You can show all that using the G-Method; in Galetto books [100-108] it is mentioned a method that allows you to find the bias of the estimate of the parameters of a "reduced model";

the same idea can be used for finding the alias structure.

From this it is easily seen that [48, 100-108, 110, § 5 a.-gg.]

a) when a full design is carried out and a reduced model is considered the estimator of β_1 is biased

b) when a *fractional design* is carried out only a reduced model β_1 , ALIASED, can be estimated.

It is not scientific and not managerial say the contrary. The right tools can be used if managers, professors, researchers, scholars do use correctly the "Knowledge Matrix".

The same G-Method allows you to find the resolution of a given design: for example, you can show that the 54-runs "combined array, allocating for three 3-level factors [X, W, Z] and four 2-level ones [A, B, C, D]" design does not appear to be a "resolution V design", unless you define "resolution" differently from the usual way: as a matter of fact A is entangled with A*B & C*W &.

If skilful people make such kind of pitfalls, what can we expect from incompetent ones? These last use Taguchi Methods and claim: "TM work", BUT they did not read Taguchi books: it was very amazing asking them "Did you read Taguchi books?". I always had the reply NO!!!

Why people act that way? I have been looking for the answer for at least 40 years: I found it during 1999 holidays: the truth does not influence them: only their conviction is reality!!!

Using Statistics correctly for the Byrne-Taguchi case, the optimum point is therefore different from the one found by Byrne-Taguchi, due to interactions.

The significance of factors and interactions is hidden (if not forbidden) by the analysis of S/N; moreover, firstly the noise factors E and F are much more important than the controlled factors A, B, C, D, secondly the interactions A*G, D*E, D*F between some controlled factors and the noise factors E, F, G are more important than the controlled factors A, B, C, D: therefore it is better to act as Rational Managers with the FAUSTA VIA (the profitable route to Quality).

Using Logic, a Rational Manager is not dazzled by (stupid) statements as those provided to students by *several professors* at Politecnico of Turin "the robust design methodology, following the modern Total Quality philosophy... (where) Taguchi proposes to use different types of response, characterised by great simplicity... today possible even for inexperienced people thanks to the diffusion of advanced statistical software.". The same professors hoaxed-missed again the problem of the alias structure! The entanglement can be found by the G-method.

Unfortunately, at least 90% of the papers on application of TM do not provide you with the alias structure. *This attitude unfortunately cheats people and robs them of their right to know.* [48, 100-108, 110, § 5 a.-gg.]

If skilful people slip into such pitfalls what can you expect from unskilled managers who act like "tamed monkeys monkeying their incompetent consultants and teachers"?

For 40 years, since 1988, R. Levi and F. Galetto have been suggesting to be cautious in using blindly some Taguchi ideas. At that date the name "G-method" was invented, but many applications of it were made before: actually the G-method is,

in few words, the correct use of the Normal Equations.

We cannot mention here all the wrong Taguchi applications that have been carried out since then: let's content ourselves of the few (out of the many) cases reported in the references. From the previous case, and the other many wrong that you can find in the literature, it is evident that a lot of disquality was generated and a huge amount of money was wasted. *Were they unfortunate?* Absolutely not, *they were a-scientific.* [48, 100-108, 110, § 5 a.-gg.]

Does Taguchi Method work???

NO, it is really robust in FAILURE!!!

"Signal/Noise ratios" used in connection with the so called Robust Design are nonsense from a scientific point of view: these are multifunctional transformations of the data, and at the end the transformed data must be normally distributed if, logically, the F ratio resulting from ANOVA and shown in the "Quality Engineering using Robust Design" books should have any statistical sense).

In many cases interactions are important; therefore it is *quite non-managerial pretending, before any test, to say (Taguchi) ". when there is interaction, it is because insufficient research has been done on the characteristic values.", or to say, after a test (Phadke), ". if we observe that for a particular objective function the interactions among the control factors are strong, we should look for the possibility that the objective function may have been selected incorrectly"*.

It is silly saying: "I was in Japan and learned: data are important; I speak with facts and figures". Interactions are really very important, according the fundamental principle F1 of GIQA [47, 48, 100-108, 110, § 5 a.-gg.].

Managers have to learn Logic, DOE, Statistical Thinking to make good decisions. Quality is number one Management goal, not only for product and services, but *for Quality methods as well.*

Again, they make decisions based on data analysis and apply correctly the (ISO 9000:2000 and 9004:2000) seventh principle "Factual approach to decision making" which states: "Effective decisions are based on the analysis of data and information". BUT their decisions are NOT effective: they are wrong! The standard ISO 9001:2015 is worse in the clause "9.1.3 Analysis and evaluation The organization shall analyse and evaluate appropriate data and information arising from monitoring and measurement. The results of analysis shall be used to evaluate: a) conformity of products and services; b) the degree of customer satisfaction; c) the performance and effectiveness of the quality management system; d) if planning has been implemented effectively; e) the effectiveness of actions taken to address risks and opportunities; f) the performance of external providers; g) the need for improvements to the quality management system. NOTE Methods to analyse data can include statistical techniques."

All the cases, F. Galetto had the opportunity to analyse, show that

facts and figures are useless,
if not dangerous,
without a SOUND theory. (F. Galetto).

Managers, professors, researchers, scholars have to learn Logic, DOE, and Statistical Thinking to make good decisions. Quality is number one Management goal, not only for product and services, but *for Quality methods as well.*

MEDITATE. The case shown in the Figure 15 from a 6σ [6S(igMona)] book gives evidence that the 6σ [6S(igMona)] BMWist Author makes the same errors, as Byrne and Taguchi!!!

If one looks carefully at the data, he finds that the ANOVA table made by the 6σ [6S(igMona)] author is FALSE and WRONG!!!

NOTICE the following comments (F. Galetto):

- the ANOVA was made using Minitab for the column of the means \bar{y} of the data that you see in the columns N1 and N2 and not on the S/N
- therefore it is not related to the S/N
- feeding the means \bar{y} to Minitab you lose 8 degrees of freedom (df) and then you have 0 df left for the Error
- therefore you cannot estimate the Significance of the factors A, B, C, D; then you are unable to optimise the response
- IF you use the G-Method (of GIQA), as shown in the this and the previous chapter, you get quite a different picture
- using the G-Method you can find the Significance of the linear and quadratic effects of the factors A, B, C, D
- moreover, you can see that the “outer factor” N is very important and
- therefore you must take into account its Significance for estimating the Significance of the factors A, B, C, D

Table 3. ANOVA of F. Galetto on the data of 6σ [6S(igMona)] case.

ANOVA of “Maximize the pull force” by G-Method, of the 6σ [6S(igMona)] case in the book						
Source	df	SS	MS	Fc	F*	Sig
total	18	7284.93		$\alpha=$	0.1	
mean	1	6809.45				
corr_total	17	475.48				
Al	1	51.25	51.25	6.55	3.46	*
Bl	1	0.40	0.40	0.05	3.46	
Cl	1	12.81	12.81	1.64	3.46	
Dl	1	6.31	6.31	0.81	3.46	
Aq	1	19.36	19.36	2.47	3.46	
Bq	1	18.49	18.49	2.36	3.46	
Cq	1	11.56	11.56	1.48	3.46	
Dq	1	8.70	8.70	1.11	3.46	
N	1	284.01	284.01	36.31	3.46	*
RESIDUAL	8	62.58	7.82			

NOTICE that the noise factor is more important than any control factor!!!

It is apparent that the two following statements of the 6σ [6S(igMona)] author in the 6σ [6S(igMona)] book

«Clearly, C is the most important factor; A and B also have significant effects on S/N. From the main-effects chart on S/N, we can see that C and A should be set at level 3 and B should

be set at level 2.»

are FALSE and WRONG (see the ANOVA table of the 6σ [6S(igMona)] author, claimed to be “for S/N” while it is for the “mean”!!!

The optimum setting of the factors IS NOT $A_3B_2C_3D_{\text{indifferent}}!!!$

Actually only the control factor A is significant.

Compare this result with the Best Technical Paper (!?) analysis of table 2.

Estimating correctly the influence of the control factors, the G-Method provides the following.

OPTIMISED	Criterion
MEAN pull of force	Maximum
Standard deviation of pull of force	minimum
S/N of pull of force	Maximum

Notice: C and D must be set at level 2 for all the three criteria; since only the factor A is Significant one has to decide IF he wants optimise

- a) the mean and then chose A2
- b) or S/N and then chose A3
- c) or the variability (standard deviation) and then chose A3

Notice: since the optimum of the pull force at $A_2B_2C_2D_2$ is not significantly different from the S/N optimum at $A_3B_2C_2D_2$ the optimum choice is $A_2B_2C_2D_2!!!$

The 6σ [6S(igMona)] professional and author did not really made improvement! (because he copied wrongly the data!!!)

5. Conclusion

The great difference between the Scientific GIQA and the a_scientific DMA(g)IC is clear by looking at the Product Development Cycle (figure 17). The PDC was developed when (1992) F. Galetto was Quality Director at Philco Italiana (PIT) and shown in the book *Qualità. Alcuni metodi statistici da Manager, CUSL, 1995*, where you find as well the Galetto’s Law.

In Product Development Cycle the reader sees that any Product/Process/Service starts with the definition of the NEEDS of the Customer/User/Society; from them the company states the Quality Tetrahedron Characteristics (Product/Process/Service Specifications, the goals!). Then the Design/Testing/ Design/Testing/ Design/Testing... cycles and Preventive Actions are implemented (see FAUSTA VIA). When the goals are achieved, the Product/Process/Service is “pre-produced” for the final release before selling. The field behaviour and the PDC cycle. TQM² (Testify Quality of Management in Management) is fundamental for goals achievement.

We end this paper with two cases of Fausto Galetto working life.

1. When he became Quality Director at Philco Italiana (PIT), 1992, he found that the company was refunding the «extra-warranty costs» to the most important Customer [that was bying 30% of the production yeld] in order to keep its loyalty. The 1st step was the agreement

with the Customer that the refund would be stopped, based on confidence that the new designed products would be "much more reliable" [a goal for the number of failures during the first 5 years life was stated]. F. Galetto Quality Department (Reliability Dept., Quality Control Dept, After Sale Dept.) was involved in all the operations of the Company and organisation was revised: the Quality Department Director had the responsibility for any decision on Quality matters. The Suppliers were asked to agree on Reliability Goals and to test components reliability: they did it at no cost for PIT... The end of the story is that "the most important Customer accepted to pay a bonus (over the price) due to the huge saving in the warranty costs generated by the products reliability". NO ISO Standards, NO 6 Σ , NO TQM, NO WAFFLE. Scientificness was in every activity and decision.

Fausto Galetto has been co-ordinator of: Reliability Working Group of CUNA (until 1989), Scientific and Technical Committee of QUALITAL (1989), Vice-Chairman of Automotive Section of AICQ (1985-1990). He left the SIS (Italian Statistical Society) and the AICQ (Italian Association for Quality) due to the ignorance and loss of commitment of their fellows and "Managers" about the Scientific Approach to Quality and to the related Quality Methods (Statistical and not).

It seems he is one of the very few who take care of "Quality of Quality Methods used for making Quality".

2. After being Quality Director at PIT, Fausto Galetto was appointed Quality&Reliability Director at IVECO (1995). The Company was involved in the design a new product range of vehicles, the SPR, aiming at produce "much more reliable" trucks [even at IVECO a goal for the number of failures during the first 5 years life was stated, 80% better than the previous products]. F. Galetto Quality&Reliability Dept. was involved in all the Design operations of the Company, Production operations, After Sales and Suppliers quality management; contray the PIT, the Quality Department Director had not the responsibility for any decision on Quality matters; the responsibility was given to the Steering Committee, for which Quality was not the primiry goal! The Suppliers were asked to agree on Reliability Goals and to test components reliability... The end of the story is that "after 5 years the some goals were attained BUT NOT all due to management resistance!")". NO ISO Standards, NO 6 Σ , NO TQM, NO WAFFLE. Scientificness was in every activity and decision, BUT it was very hard... TOP managers were not really committed to Quality!

MEDITATE. So the reader can see clearly that actually 6SigMona is hyped by the incompetents consultants: the tools hyped DO NOT deal with the «Customer's needs»!!! [48, 100-108, 110 a-gg]

Ignorance is growing: see fig. 16

Only GIQA [see figure 18, the GIQA Tetrahedron (with the three Fundamental Principles F1, F2, F3)] helps Managers, Researchers, Scholars in their work.

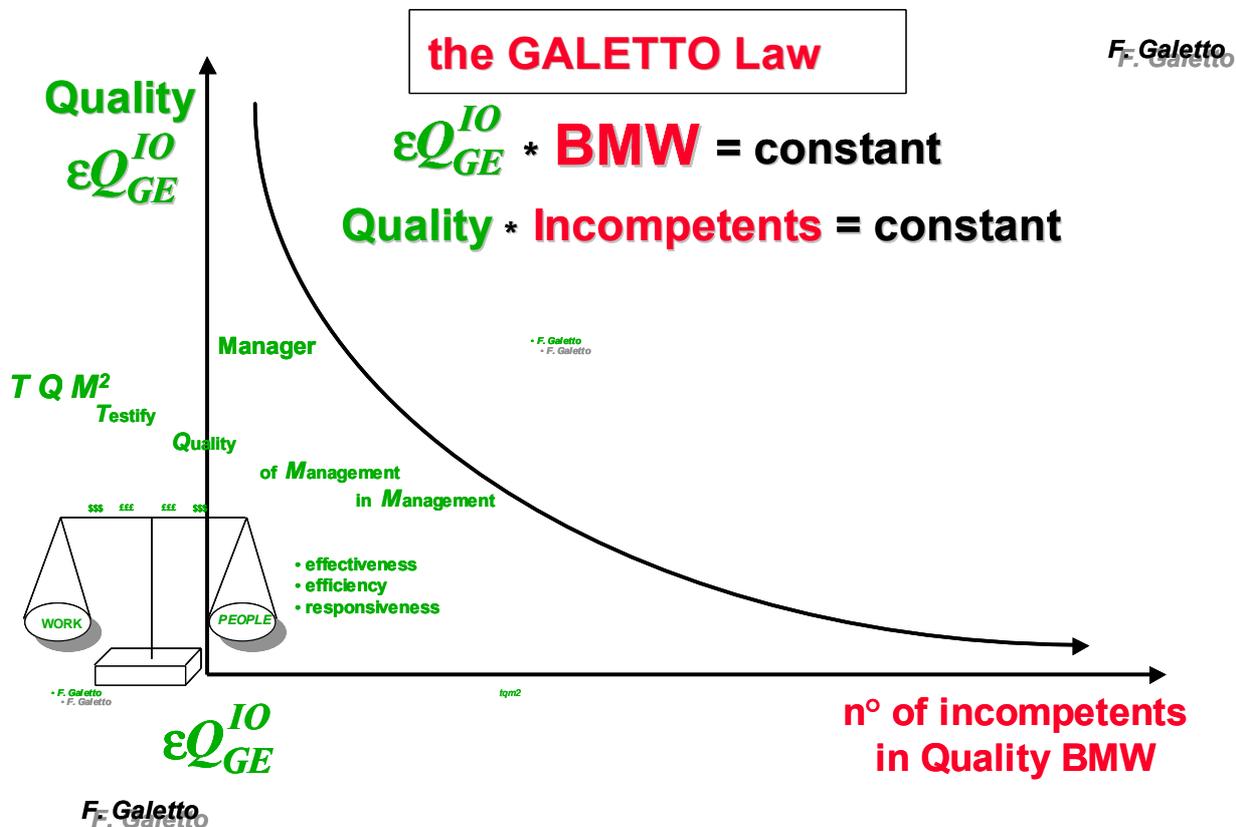


Figure 16. The Galetto Law (as far as 1995): Quality decreases due to the increasing number of incompetents.

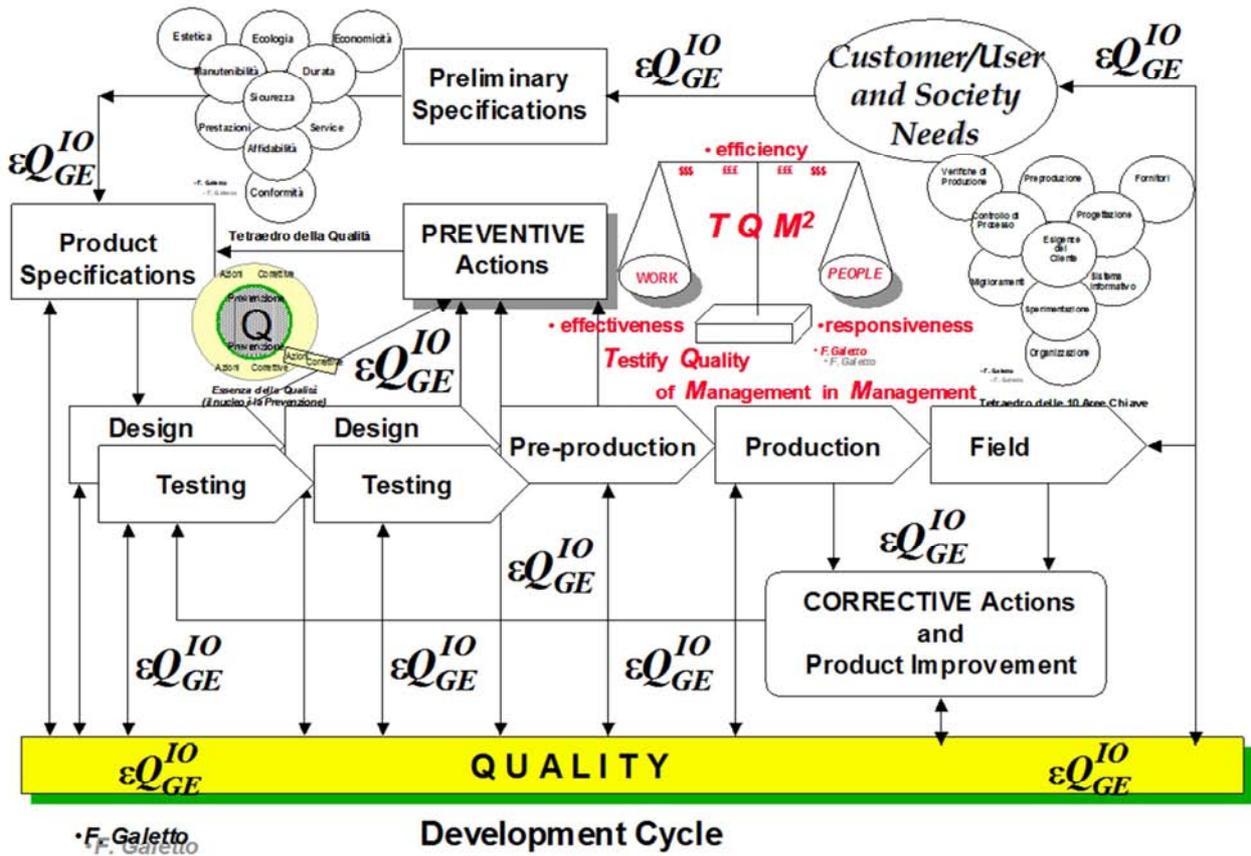


Figure 17. The Development Cycle.

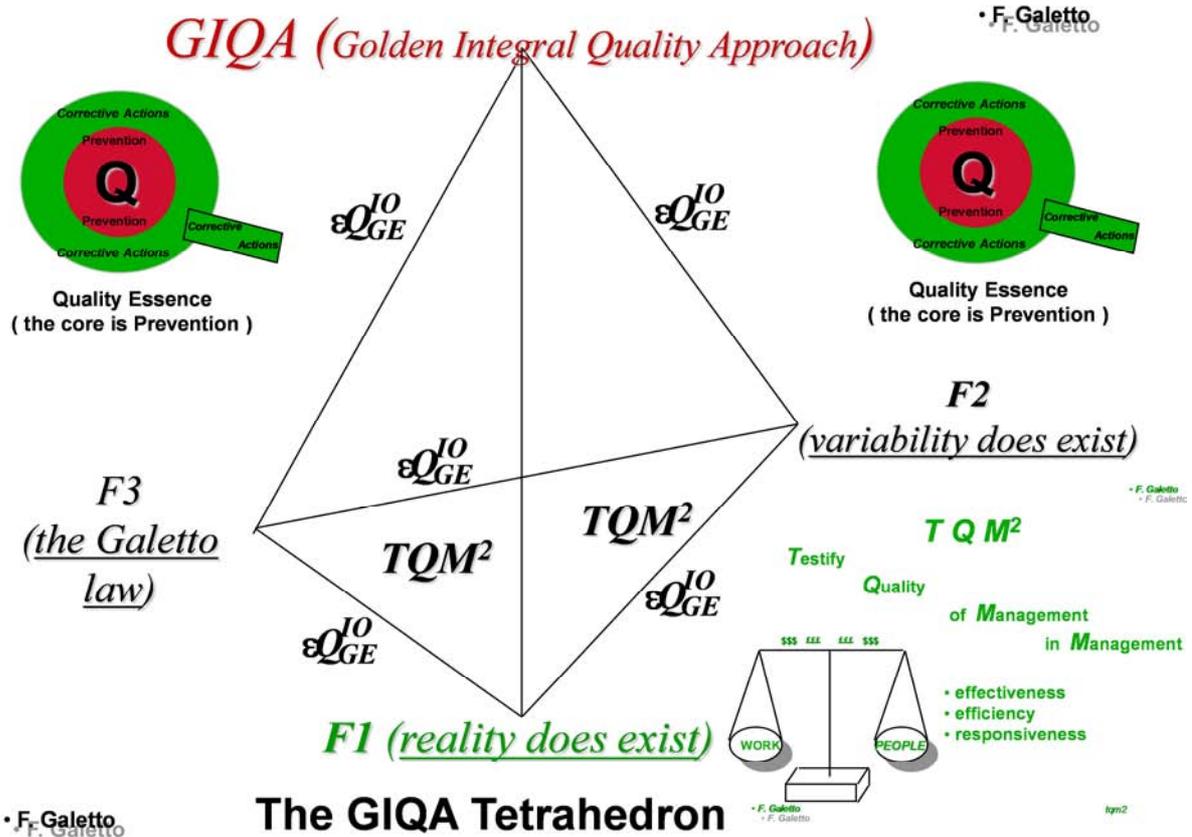


Figure 18. The GIQA Tetrahedron (with the three Fundamental Principles F1, F2, F3).

Reader, are you aware that Fausto Galetto has as much knowledge and expertise (see all the references) to write about the many drawbacks of the 6Σ [6S(igMona)] movement and the incompetence of the 6Σ [6S(igMona)] professional?

Remember Deming and Gell-Mann.

Scientificness is absent in the “6 SigMONA applications” as can be evinced in the authors books [100-108].

The “*Profound Knowledge*” concept of W. E. Deming [1, 2] states that variability is a law of nature, as stated by the Principle F2. It is the foundation of the quantum mechanics.

The quantum mechanics which describes the dual nature of the quantum particle (photons, having energy and momentum, for light or mass particles, having wave-length); such entities have both particle and wave characteristics, and we must choose one appropriate behaviour—particle or wave—to understand a particular phenomenon.

The periodic table of the elements is completely explained by quantum theory; associated with any particle there is the amplitude of the wave, called the probability amplitude, or the wave function, which has the symbol Ψ . In general, the complete wave function Ψ for a system depends on the positions of all the particles in the system and on time; for many systems of interest, including all those we study in this text, the wave function Ψ is mathematically separable in space and time and can be written as a product of a space function for one particle of the system and a complex time function.

For one-dimensional systems, where the particle must be located along the x axis the probability that the particle will be found in the infinitesimal interval dx around the point x is $P(x)dx=|\psi|^2dx$; the function ψ is the solution of the time-independent Schrödinger equation

$$-\frac{\hbar}{2m} \frac{d^2\psi}{dx^2} + U\psi = E\psi$$

where for a particle of mass m confined to moving along the x axis and interacting with its environment through a potential energy function $U(x)$ and E a constant equal to the total energy of the system (the particle and its environment).

Leptons, Mesons, Baryons are ruled by the equation; from it we have the important Heisenberg uncertainty principle stating that “if a measurement of the position of a particle is made with uncertainty Δx and a simultaneous measurement of its x component of momentum is made with uncertainty Δp_x , the product of the two uncertainties can never be smaller than $\hbar/2$ that is $\Delta x \Delta p_x \geq \hbar/2$.

So it is clear that variability is not the “enemy”. See the following documents from a. to gg. (for the interested reader, they are in the Research Gate database)

- a. F. Galetto, Hope For The Future; overcoming the DEEP Ignorance on the Confidence Intervals 2014! QFG Quality MUST be loved, DISquality MUST be hated.
- b. F. Galetto, Case n° TWENTYTHREE; VERY BAD MISTAKES on Weibull data analysis by authors with High RG Scores and High Impact Points! QFG Quality MUST be loved, DISquality MUST be hated.
- c. F. Galetto, Case n° TWENTYTWO WRONG probability ideas on Insurance Mathematics and Economics ManEdit and Reviewers NOT reliable
- d. F. Galetto, ANOVA and Least Squares Estimation Some BASICS! Quality MUST be loved, DISquality MUST be hated.
- e. F. Galetto, Case n° TWENTYONE; A WRONGLY AWARDED wrong paper of on DOE, awarders are NOT reliable! Quality MUST be loved, DISquality MUST be hated.
- f. F. Galetto, Quality Engineering vs “mathematicians” - QFG: case n° TWENTY, QE wins!_MANY WRONGS do not make a right; Quality MUST be loved, DISquality MUST be hated.
- g. F. Galetto, Case n° NINETEEN, a WRONG Taguchi application AGAIN, REFEREES are NOT reliable! Quality MUST be loved, DISquality MUST be hated.
- h. F. Galetto, Second Addendum to Case n° EIGHTEEN, PEERS INCOMPETENT; Quality MUST be loved, DISquality MUST be hated for RG-2014
- i. F. Galetto, Addendum to Case n° EIGHTEEN, PEERS INCOMPETENT; Quality MUST be loved, DISquality MUST be hated for RG-2014
- j. F. Galetto, Case n° EIGHTEEN, PEERS INCOMPETENT; Quality MUST be loved, DISquality MUST be hated for RG-2014
- k. F. Galetto, Case n° SIXTEEN; SECOND PART, other WRONG ideas of D.C. MONTGOMERY!!!! Quality MUST be loved, DISquality MUST be hated.
- l. F. Galetto, Case n° FIFTHTEEN; the G-Method for MANOVA versus INCOMPETENT REFEREES !!!! (WRONG Taguchi applications) [ANOVA dealt in cases n° NINE and ELEVEN], THIRD part
- m. F. Galetto, Case n° FOURTEEN; MANOVA of another WRONG Taguchi application [ANOVA dealt in case n° ELEVEN], REFEREES_INCOMPETENT!!!! SECOND part
- n. F. Galetto, Case n° THIRTEEN; some WRONG ideas of PROFESSOR D.C. MONTGOMERY!!!! FIRST PART_Quality MUST be loved, DISquality MUST be hated.
- o. F. Galetto, Quality Education on Quality and Design Of Experiments
- p. F. Galetto, Case n° TWELVE; MANOVA of a WRONG Taguchi application, REFEREES are NOT reliable! Quality MUST be loved, DISquality MUST be hated.
- q. F. Galetto, Case n° ELEVEN; another WRONG Taguchi application, REFEREES_INCOMPETENT!!!! FIRST part Quality MUST be loved, DISquality MUST be hated
- r. F. Galetto, Case n° NINE; a WRONG Taguchi application, REFEREES are NOT reliable!!!! Quality MUST be loved, DISquality MUST be hated.
- s. F. Galetto, Confidence Intervals (Classic Statistics) versus Credibility Intervals (Bayesian Statistics), first part

- t. F. Galetto, Confidence Intervals (Classic Statistics) versus Credibility Intervals (Bayesian Statistics), second part
- u. F. Galetto, Quality of Quality Methods is important
- v. Galetto, F., VIPSI_Belgrado2009-10_Pentalogy
- w. Galetto, F., THE CHALLENGE FOR THE FUTURE: QUALITY EDUCATION ON QUALITY FOR MANAGERS
- x. Galetto, F., QUALITY IN HIGHER EDUCATION COURSES
- y. Galetto, F., Decisioni Aziendali e Metodi Statistici
- z. Galetto, F., Quality and "quality magazines"
- aa. Galetto, F., Quality Education for Professors Teaching Quality to Future Managers
- bb. Galetto, F., QUALITY AND "STATISTICAL PACKAGES"
- cc. Galetto, F., Looking for Quality in "quality books"
- dd. Galetto, F., Does "Peer Review" assure Quality of papers and Education?
- ee. Galetto, F., IGNORANCE vs PRESUMPTUOUSNESS
- ff. Galetto, F., The Quality Manifesto_2014_01_07
- gg. Galetto, F., Qualitatis_FAUSTA_GRATIA

Appendix

We present here the way to test the “magic number 3.4 ppm”.

The 6σ [6S(igMona)] professionals and books authors never say how to do it!!!

The reader can find the Theory in the Galetto’s books [102-108]: there we give the concept of “Associated system to a test”; in our case the system is depicted in the following figure 19:

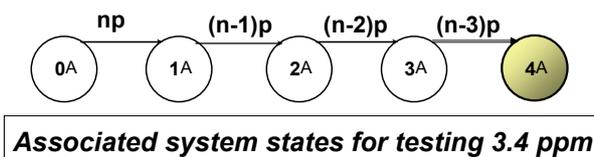


Figure 19. The Associated System for testing 3.4 ppm.

The state 0 is the state where 0 defects are found in a sample of size n; p is the probability of transition due the defectiveness for each product: np then is the “transition rate” from the state 0 to the state 1, where 1 defective is found.

The same happens for the other states.

When the system enters the state 4, the system is down.

For testing the “magic number 3.4 ppm”, the goal, in the 6σ [6S(igMona)] framework the probability is $p=3.4$ ppm!

Let’s assume that we want to be $1-\alpha=0.9999$ confident that the goal is achieved [risk $\alpha=0.0001$ of being wrong].

The sample size n is the number needed for getting a probability, $P(UP)\leq\alpha=0.0001$, that our system is in a state < 4, when n data are considered.

For state 3 (UPstate) we need a sample size $n=4680534$.

For state 2 (UPstate) we need a sample size $n=4096521$.

Why the 6σ [6S(igMona)] BMWists do not give us this

information?

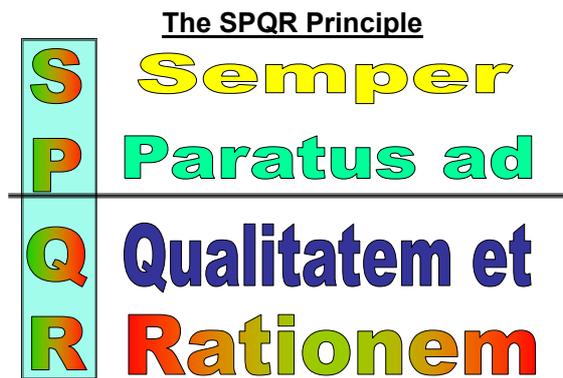
Reader, use the SPQR Principle, to understand...

The reader SPQR can compute the RV "Range" $R=\max(X_i, i=1, n) - \min(X_i, i=1, n)$, with the Theory in the Galetto’s books [65, 103-108]: if $X_1, X_2, \dots, X_j, \dots, X_n$, are the RV with distribution $F(x)$ the pdf of R is

$$g(r) = n(n-1) \int_{-\infty}^{\infty} \{F(x+r) - F(x)\}^{n-2} f(x+r)f(x)dx$$

When $F(x)=N(x; \mu, \sigma^2)$ we get $E(R) = d_2\sigma$,

$$Var(R) = d_3^2 \sigma^2.$$



The SPQR Principle

Figure 20. The SPQR Principle.

For state 3 (UPstate), with $n=4680534$, we can compute $E(R)$ and see if $6E(R) < USL - LSL$; in such a case we have...

Notice that the 6σ [6S(igMona)] BMWists aim at the “magic number 3.4 ppm” in the production output and ONLY at 3700 ppm for control charts!

WHY?

Contradiction!

They do not know the “Profound Knowledge” concept of W. E. Deming [1, 2].

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Biography



Fausto Galetto (born Italy 1942) received Electronics Engineering and Mathematics degrees (Bologna University, 1967, 1973).

1992-2012 Professor of "Industrial Quality Management" at Politecnico of Turin.

1998-2001 Chairman of the Working Committee "AICQ-Università" (AICQ) for Quality in Courses about Quality in Universities.

Eight books and 200 papers on Reliability, Quality (Management, DOE, Applied Statistics, Testing, Process Control).

Reliability Engineer with General Electric, 2 years, before the 6σ [*6S(igMona)*] movement), from 1975 to 1982 Reliability Manager (Fiat Auto); Quality Dept. Director (Philco Italiana 3 years). 1985-1990 Director of the Quality/Reliability Dept. at Iveco-Fiat, since 1990 Quality Management consultant. Lecturer with AICQ/COREP (1980-2012).