SIX SIGMA: GENERATING IMPROVEMENTS AND CHALLENGES

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Abstract:
Following decades of developments within the area of quality management, contemporary research came to embrace the concept of Six Sigma – business strategy that was developed within the manufacturing environment, that increased its importance and came to be used quite extensively also in the service industry.

Summary: This article begins by describing the history of the attention provided to quality and then a presentation of the concept of Six Sigma. What is Six Sigma? Where is it being applied? who interests it? why do we need Six Sigma, and where to apply it – answers to these questions will be provided in the second part of the article.
This article is describing the standard Six Sigma methodology, which is composed out of 5 stages: Define, Measure, Analyse, Improve, and Control (DMAIC), which together with the corresponding statistical and managerial tools are used in order to sustain the process.
In the third part of the article, a couple applications of Six Sigma are reviewed, and then in the end of the article the emphasis is being placed on perspectives and conclusions.

The quality concept, as a term, traces its roots in latin, originating from the word «qualis», which had a meaning of – way of being. The awareness of quality is present in the history of humanity since antiquity; it can be identified with the works of Aristotle, Hagel, being present even also with Dimitrie Cantemir. Following progress in manufacturing, quality moved from not being solely a philosophical concept, but an economical one, becoming an interest for most organisations, being carried out through management.
Prior to the industrial revolution, manufacturing was viewed as an art, and quality, the measure of this art. This perception was due to the specialisation of the work that everyone was performing, the master craftsmans were viewed as artists, they were producing works of art and their apprentices looked up to them with expectations of being able to improve their skills with the help of their masters. James Watt brought a fundamental change on work processes through the development of the steam engine, which determined manufacturing to become systemic and collective, resulting in the worker’s depersonification and the necessity for supervision and quality control of every manufactured product. These 19th century changes to the way manufacturing is managed had beneficial consequences concerning quality.

With the involvement of innovators like Frederick Taylor, the father of scientific management and one of the first management consultants, the importance of workers specialisation was highlighted together with the progress of quality. Taylor made his contribution to the development of quality management by placing emphasis on standardisation and best practices.
Henry Ford highlighted the importance of processes and lean manufacturing, his quality management practices becoming materialised in the assembly lines, beginning with the
Ford Age, companies came to focus more and more on low cost manufacturing with improved efficiency.
Walter A. Shewhart (1924) made an important contribution towards developing quality management by using statistical models as a manufacturing quality control tool. W. Edwards Deming continued Shewhart’s work and applied, during WWII, the statistical models within army manufacturing.
Following Second World War, Japan valued quality extensively, quality being a cornerstone on which the national economy got re-built.
W. Edwards Deming promoted Shewhart’s ideas in Japan, becoming recognised for his philosophy of promoting quality and productivity as elements of the competitive advantage.
During the ‘50s and ‘60s, Japanese products were perceived as being cheap and low quality, but in the ‘70s quality initiatives became to be successful. Various quality practices were developed during this time in Japan: Taguchi, QFD, Toyota Production System.
In the ‘80s, once they realised that they are falling behind the Japanese manufacturers, Ford Motor Company requested Deming’s support in drafting the company’s quality strategy. In 1981, Ford’s sales were falling, during 1979-1982, Ford suffered 3 billion $ in losses. Deming questioned the organisation’s internal culture and for everyone’s surprise Deming didn’t emphasised on improving quality but on improving management. Deming highlighted that management determines 85% of the factors that disable Ford from developing some improved cars. In 1986, Ford became the most profitable American manufacturer and for the first time from the ‘20s, it’s revenues overpassed the one’s of rival General Motors (GM).
Total Quality Management or TQM is a management philosophy which looks to drive continuous improvement for products and processes. In TQM, the whole organisation and all its members are expected to take part in the continuous improvement effort, in developing processes/products/services etc.

The basis of TQM is represented by the fact that products and processes quality falls under the responsibility of all parties involved in the creation and consumption of products and services that are offered by the organisation. In this way TQM is enabled by management, workforce, suppliers and even customers so that expectations are assured and even exceeded.
We can count a couple TQM promoters, that were able to conceptualise and describe the ways it is being implemented: W. Edwards Deming, Iosif M. Juran., Philip B. Crosby, Armand V. Feigenbaum si Ishikawa Kaoru.
Six Sigma was developed by Motorola in 1986, as a way for the organisation to be able to decrease defects by reducing the process variation.
Main difference between TQM and Six Sigma is determined by the way the quality management approach is being carried out. Peter S. Pande, Robert P. Neuman and Roland R. Cavanagh present a series of differences between the two concepts while also mentioning that the errors of TQM might still happen in the implementation of Six Sigma.
• in TQM it was noted that the quality circles were quite often composed of delegates and the authority for taking/implementing decisions was not effectively delegated; it is considered that within the Six Sigma organisations, process assessment and improvement is one of management’s daily tasks.
• quite often within TQM – a leadership apathy is felt towards implementing quality improvements; this being opposite to the Six Sigma organisations where leadership approaches quality initiatives with passion.
• TQM is viewed to hold some unclear goals like «satisfying and exceeding client’s expectations» while Six Sigma has a clear goal, extremely challenging but attainable (as opposed to «zero defects»), being expressed as a ratio (99,99966% perfection), number of defects per million opportunities (3.4 DPMO) or by sigma (6σ);

• TQM is focused on improving product’s quality, despite it’s name – Total Quality Management – most organisations focused on manufacturing processes, disregarding marketing, services, logistics, sales, etc. Six Sigma through it’s approach can be considered being even more total that TQM.

What is Six Sigma ? The term comes from manufacturing, from the area of statistical modeling. Sigma is the value of a variable which reflects the output of a process, the distribution of a characteristic. In a six sigma process there are only 3.4 defects per million opportunities – 99.99966% of the outputs are defect free.

Six Sigma is centered on the customer, identifying customer needs/expectations and working towards eliminated the sources that generate errors/defective output; by reducing the process variation the process improvement is enabled which in turn determines a decrease in costs and increase in profits.

The need for Six Sigma emerged at Motorola in the ‘70s when executives as Art Sundry were publicly complaining the poor quality of Motorola’s products. If the traditional view was that quality is expensive, Motorola found the way of driving improved quality at improved costs. Bill Smith, an Motorola employee, drafted the Six Sigma methodology in 1986, getting inspiration out of various concepts like quality control, TQM, Zero Defects.

Similar to the quality concepts that preceded Six Sigma, continuous efforts are deemed as necessary in order to ensure stable and predictable results that would determine the organisation’s performance and success. It is considered and manufacturing and business processes, hold characteristics that can be measured, analysed, improved and controlled; and these improvements can be generated only with the effort and involvement of the whole organisation – especially the leadership.

Six Sigma also introduced some elements that prior, weren’t approached so thoroughly: focus on improvements that are generating financial benefits; emphasis on leadership’s importance; belt infrastructure; decision-making based on facts and data.

The set of tool used within Six Sigma is composed of methods and instruments that were developed prior to Six Sigma emergence: fishbone/cause-effect diagram (Ishikawa); control chart, CTQ, histograms, pareto, Quality Function Deployment, SIPOC analysis, Taguchi methods.

Each Six Sigma project developed within an organisation should follow a couple of steps prior to attaining the goal specified initially, which has to be linked to the financial goals (reduce expenses /increase profits).

The Deming cycle (PDCA – Plan, Do, Check, Act) inspired two Six Sigma project methodologies:

• DMAIC (define, measure, analysis, improve, control) is used for projects that target the improvement of a process that already exists.

• DMADV (define, measure, analysis, design, verify) is used on projects where the development of new products/processes is targeted. It can also be met as DFSS (Design for Six Sigma)

DMAIC is made-up out of 5 phases, where the first – Define – has the purpose of defining the problem as highlighted by the Voice of the Customer (VOC).
Within Define, the customers and their needs are established, together with the project purpose, project team, process that is being improved and the assignment of tasks. The critical to quality (CTQ’s) characteristics are being identified – these being the measurements that should be targeted in order to drive customer satisfaction. The project charter is drafted; this being the document that encompasses the purpose and project plan, financial gains, project team, this charted being the blueprint for the project. At the end of define a graphical highlevel representation of the process is due to be performed, with a COPIS look.

In Measurement the key aspects of the current process are checked, the critical to quality characteristics are being looked at in order to identify sources of variation and depending on these performance standards can be established, what is the process that has to be measured, how will it be measured, at what extent the variation will be deemed as within tolerance limits. The measurement system is also looked at, a valid system being the one that issues the level of information that represents correctly the process output. Data analysis takes place in order to identify causality relationships; to what extent can the process generate defect free output, the performance targets are met, what is the expected defect reduction, variation sources are being identified, variables that might block the road to meeting the objectives.

Within the Improve stage, variation sources are being verified and once the operational tolerances are being developed the proposed solution can follow, implementation is usually carried out with a pilot phase, in order to test the solution, provide a better understanding of the effects and identify the ways of carrying out the general implementation with a high grade of efficiency and effectiveness.

In Control, the new process is being tracked and monitored in order to keep it’s performance at high levels, in order to drive customer satisfaction and enable continuous improvement.

The methodology and instruments used within a Six Sigma project can provide a feel with regards to this concept, draft it’s image, this being extensively improved in the last couple years due to the major opportunities that were identified. In their book "What is Six Sigma?", Peter Pande and Lawrence Holpp (2002), present a series of Six Sigma applications, instances where Six Sigma contributed to eliminating a great array of issues within a great array of companies/industries.

An organisation that was dealing with the repair of home appliances came to be aware of the necessity of being capable to return these within the turn around time that was being initially communicated to it’s customers. A DMAIC taskforce was deployed to analyse the causes that determined a delay in repairs; one of their conclusions was that the lead time for the repairs to be performed was solely one of the issues, while some great amounts of time were lost in transport of equipment from and out of the repair shop, this causing most of the delays.

An IT company, specialised in the sale of hardware equipment, was using a call center for order management. Although the sales were large and the customers were considered to be satisfied with the company, the cash-flow was suffering as close to 12% of the payments were delayed by more than 90 days. In a traditional approach maybe most companies would have carried out some investments in their collections to enable a better control on their accounts receivables.

On this instance the company’s finance department decided to deploy a DMAIC project, and since the beginning, on the stage of collecting the Voice of the Customer – it became apparent that the customers were not that satisfied as it was initially thought, especially the ones that were showing with delayed payments – this apparently being due to the fact that
the invoices were wrong, deliveries were incorrect or dispatched to the wrong places. The errors in deliveries lead the project team to carry out a more in-depth analysis which uncovered the fact that quite extensively the company was processing some incorrect orders, this being due mainly due to the fact that the call center was picking the orders in error.

The performance of the call center agents was measured depending on the number of calls that each of them was processing and thus in the case of the complex orders that were picked over the phone, were processed superficially this causing all the issues that followed – incorrect orders/deliveries/invoices/payment delays. The solution was tested on a pilot group, which were provided with a new set of criteria for assessing performance, which included besides the number of processed calls also an accuracy bit. Within the pilot group it was noted an 80% decrease in the number of errors; and through the general implementation of the solution the delayed payments got reduced by more than half, as the most important cause of the defects was eliminated.

A car manufacturer used Six Sigma in order to identify and prioritize customer needs; one of the issues that were identified being the malcontent that some customers expressed with regards to difficulties in closing the hood. Following intensive data analysis the project team was able to identify the cause and through control variation this one was eliminated.

The Six Sigma methodology for quality improvement currently represent one of the most debated topics in the area of quality research; quite often the expectations being exaggerated, determining a powerful contrast to the fact that major saving are not always generated through six sigma deployment.

Six Sigma is usually being used within the large organisations, one of the most important Six Sigma promoters is General Electric who in 1998 announced that they achieved close to 350 million USD in savings amount that eventually grew to 1 billion USD. Organisations with less then 500 employees are viewed as less fitted for Six Sigma implementation, this being due on one side because of the specialised belt infrastructure (yellow/green/black) that needs to be setup and also because usually the large organisations behold some larger opportunities for the type of improvements that are targeted by Six Sigma.

Six Sigma critics derive from the fact that it is based on a very strict methodology which indeed can drive improvements when applied on complex processes but on the other side has a tendency of blocking the revolutionary improvements, which would radically transform the entire process.

Undoubtedly Six Sigma is a consistent approach to quality improvement and it’s rigor contributes to achieving high results by improving process variation, although it is debatable whether on some instances the same results can’t be obtained through making use of the quality tools in a slightly different manner than the way it is required by DMAIC. Six Sigma is highly regarded as useful when deployed solely as a set of tools and integrated within organisations and is not recommended for it to take over organisational culture and creativity.

Bibliography :

- Dirk Dusharme, Six Sigma Survey: Breaking Through the Six Sigma Hype, Quality Digest.
• Hindo, Brian (6 June 2007). At 3M, a struggle between efficiency and creativity. Business Week.
• Ionita, Ion (2002). Managementul calitatii sistemelor tehnico-economice. Editura ASE.
• Kieran Walshe; Gill Harvey; Pauline Jas (15 November 2010). Connecting Knowledge and Performance in Public Services: From Knowing to Doing. Cambridge University Press. ISBN 978-0-521-19546-1.
• http://www.som.cranfield.ac.uk/som/dinamic-content/research/cbp/CBPupdate1-SixSigmaFriendOrFoe.pdf