6 σ?
SIX SIGMA: MYTH?

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The textbook approach is that six sigma is a whole system approach for improvement of quality and customer service so as to improve the bottom line. It is also said that six sigma requires a total culture throughout an organisation whereby everyone at all levels has a passion for continuous improvement with the ultimate aim of achieving virtual perfection and customer satisfaction. Textbooks stress that six sigma aims for total customer satisfaction. However, as often is the case, reality is not the same as textbook theory. Many organisations use six sigma as a means of reducing costs rather than improving customer satisfaction. Nonetheless, very real cost savings continue to be reported from the use of six sigma.

Six sigma as a quality programme has been around for over 20 years, but is still not fully understood by most managers and is often seen by people in the lower levels of an organisation as a cost cutting exercise. Indeed, it cannot be denied that many organisations have used six sigma purely as a means to restructure and to cut costs. Others see six sigma as a statistical black art too expensive and too hard to implement, still others see it as just another fad designed to keep consultants in business. So, what is six sigma and how can six sigma be used to provide benefits to an organisation?

Sigma is the classical Greek letter σ that is used in mathematical and statistical models to signify the standard deviation from the mean. In simple terms, the mean is the mid-point of a sample or of a total population. One standard deviation from the mean in a typical distribution is shown as plus or minus one sigma from the mean and represents 68.27 per cent of the total population. Six standard deviations from the mean is shown as plus or minus six sigma (6 σ) from the mean and equates to 99.9996 per cent of the total. In a quality programme, the higher the sigma the closer to zero defects. With one sigma, 68.27 per cent of output will meet required standards, which means for every million produced or delivered, there will be 317,300 below the required standard. With three sigma, 99.73 per cent of output will meet requirements, and there will be 2,700 out of one million below standard. Six sigma represents 3.4 errors per million opportunities, or in effect zero defects. Six sigma, however, is not just a statistical approach to measure variance; it is a process and culture to achieve operational excellence. So, how does this differ from Total Quality Management (TQM)? In fact, there is very little difference to the original TQM concept. TQM dates back to the 1950s and the turnaround in quality in Japan led by statisticians such as Deming and Juran. By the 1980s, TQM was everywhere, and sayings synonymous with TQM such as 'work smarter, not harder', 'right first time, every time', 'quality is free', 'fitness for purpose', 'the customer is king' became hackneyed clichés. By the 1990s, many regarded TQM, especially in the USA, as a concept or ideal which could not be faulted in principle, but which in practice failed to deliver. Some believed that TQM had become too politically correct, more concerned with the softer issues of culture, consensus and staff involvement than with the harder issues of measurement and management. Against this background Six Sigma emerged to replace the tired TQM philosophy.

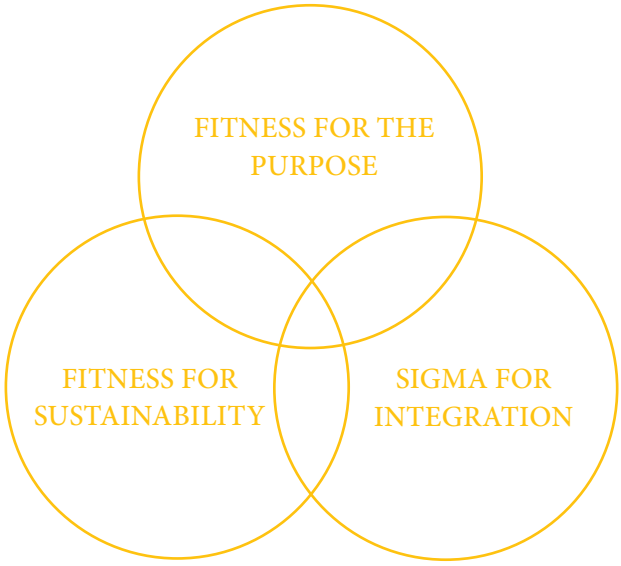
The roots of Six Sigma as a measurement standard can be traced back to Carl Frederick Gauss (1777-1855) who introduced

the concept of the normal distribution curve. In the 1920s, Walter Shewhart, using Statistical Process Control charts (SPC), showed that three sigma from the mean is the point where a process requires correction. Many measurement standards such as Crosby's zero defects emerged, but credit for coining the term 'Six Sigma' goes to Bill Smith, a Motorola engineer. (Incidentally, 'Six Sigma' is a federally registered trademark of Motorola).

In the early and mid-1980s, under Bob Galvin, Motorola engineers decided that the traditional quality levels – measuring defects in thousands of opportunities – was not sufficient and they moved to measurement of defects per million opportunities. Motorola developed this new standard and created the six sigma methodology. It is claimed that six sigma helped Motorola realise powerful bottom line results in their organisation of more than $16 billion in savings.

Many of America's business leaders, in particular Jack Welch of General Electric, praised the benefits of six sigma and, as a consequence, hundreds of companies around the world adopted six sigma as a method of reducing waste and of obtaining a consistent level of quality. Generally, it was considered that six sigma was best applied to large organisations. Training for six sigma, which included progression through various levels of six sigma methodology (green belt, black belt and master belt to indicate level of expertise) was expensive.

In our book *Quality Beyond Six Sigma* (Basu and Wright 2004) we extend the six sigma approach to include all sizes and types of organisation and show a do it yourself method to 'fit' six sigma methods to your operation. We call our approach FIT sigma. FIT sigma has three aspects which include fitting six sigma to your organisation (fit for purpose), six sigma and lean sigma to reduce variation, and FIT sigma for sustainability.

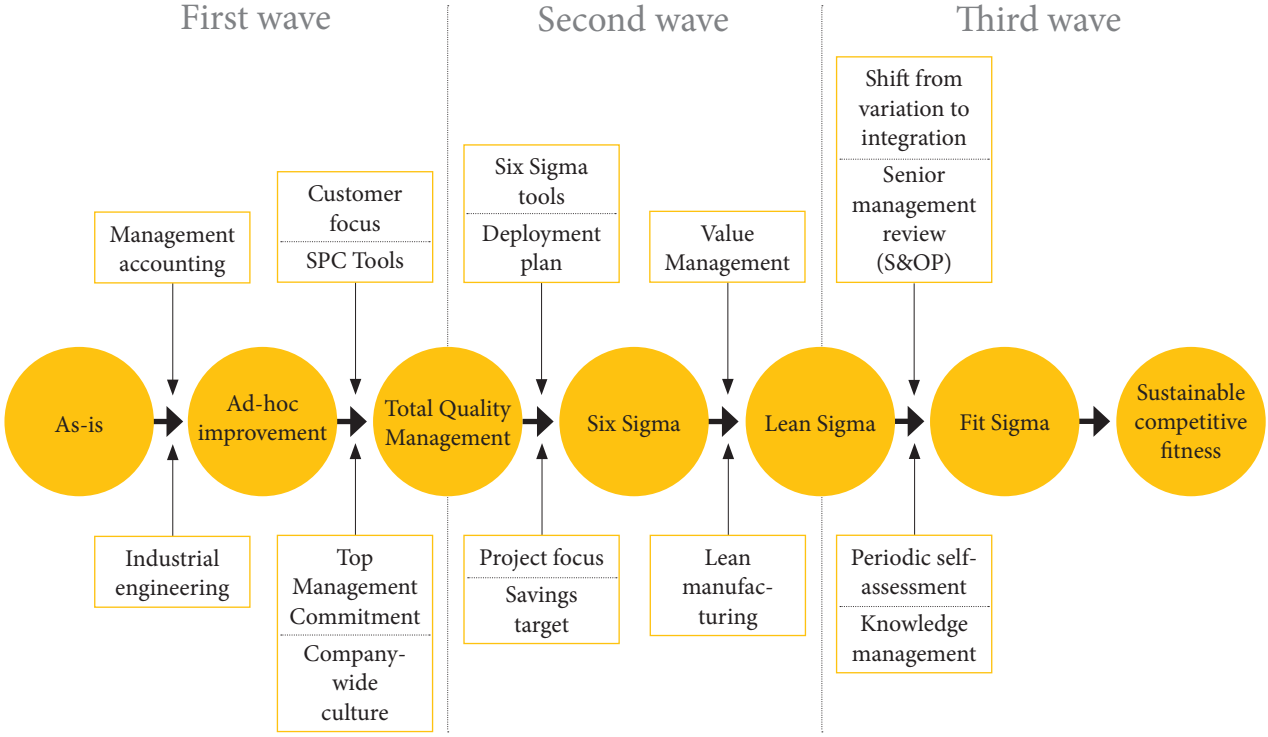


The model overleaf shows the evolution from TQM to FIT Sigma in three waves. The bridge between the second wave and the third wave is Lean Sigma. Lean Sigma builds on the Just-in-Time (JIT) manufacturing approach where materials are ordered to arrive just when required in the manufacturing process and no buffer stocks or outputs stocks are held with finished goods being delivered direct to the next customer in the supply chain. In manufacturing, monitoring performance is straightforward. Beginning with receipt of input materials, suppliers can be judged if they are achieving six sigma. Likewise, six sigma measures can be set for suppliers through every stage of production including accuracy of invoices. Internally, own performance is easy to measure (Is production to specification? Are finished products delivered on time and in the right quantities?).

In the production process itself, stocks of raw materials, waste and scrap in production, idle time, down time, buffer stocks of material, production cycle time, and costs of delays and failures to conform to standards in all areas lend themselves to specific six sigma projects.

FIT Sigma can be compared to going to a fitness trainer. The trainer will first determine your level of fitness and will ascertain why you want to get fit. The type of sport you want to excel at will determine the actions you must take. Different disciplines require different levels of fitness; running a marathon requires a different preparation from running 100 metres. Once the trainer knows your existing level of fitness and why you want to improve your level, he or she will prescribe a regime of exercises and diet to get you up to the desired level. Getting fit will be hard, but the hardest task will be staying fit. The same applies to any organisation. The first step will be to determine the base level by measuring existing standards of performance. With FIT sigma, the next stage is to establish what is important and what isn't. We don't believe that it is necessary, or even feasible, to aim for six sigma standards for every activity. We argue that it is only necessary to achieve six sigma for critical activities. For example at Frankfurt airport, six sigma does not mean 3.4 crashes for every million landings as nothing less than a 100 per cent safety record is acceptable. However, there are other activities at the airport where six sigma rigidity is not essential. Once it is established what is critical and actions have been taken to measure and to improve performance, the next and hardest stage is sustainability. Staying fit is the biggest challenge for any athlete or sports person. We also argue that getting fit does not mean losing weight. Generally, a skinny underweight person is not a healthy ➜

THE EVOLUTION OF TQM TO FIT SIGMA



person. Getting fit might mean losing fat, but for sure it will also mean building up muscle. So, too, with the organisation. FIT sigma will mean eliminating non value adding activities (losing fat), but it will also include building up and adding extra resource (muscle) where required to achieve and sustain six sigma in the critical areas of the operation.

Knowing what to measure is just the start. Recording the process requires a process and discipline. Measurement is time consuming and costly and is non value adding unless action is taken. In critical areas, once it has been established that performance is below six sigma, then action has to be taken to find and to eliminate the cause.

With Lean sigma, six sigma measures are applied back up the supply chain through the various tiers of suppliers.

Once sustainability is added to variation control of six sigma and waste control of lean, we have FIT sigma.

BASIC SIX SIGMA TOOLS ARE:

- Pareto analysis
- Flow process charts
- Upper/lower level control charts
- Cause and effect analysis
- The seven wastes
- The five S's

ADVANCED TOOLS ARE:

- Failure mode and effect analysis
- Design of Experiments
- Design for six sigma

It would require a text book to give full justice to these tools. The following is a very basic summary of each.

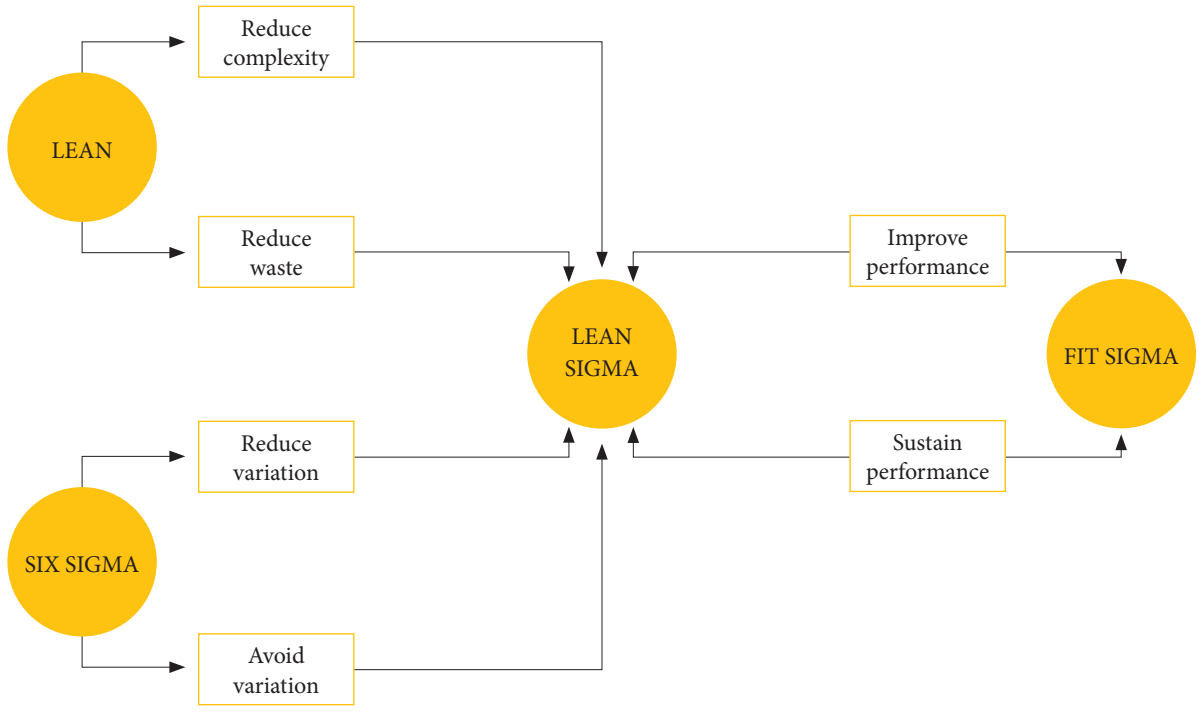
Pareto analysis: Also known as 80/20 rule (the vital few and the trivial many). The technique is to collect data of defects, identify which occur the most and which result in the most cost or damage.

Flow process charts: Used for charting the sequence and flow of a product or procedure by recording all the activities in a process

Upper/lower level control charts: Upper and lower control charts are used to show variations from specification. With six sigma, the aim is to reduce the control limits so as to force improvements

Cause and effect analysis: Sometimes known as Ishikawa diagram or fishbone diagram. The premise is that when a problem occurs, the effect is obvious and the tendency is to treat the effect rather than to determine the cause. If the cause is eliminated, the effect will not re-occur.

LEAN SIGMA



The seven wastes: Also known as Mudas representing non value adding. These consist of:

1. Excess production
2. Waiting, Idle time
3. Conveyance
4. Motion
5. Process
6. Inventory
7. Defects

The five S's: Japanese words for excellent house keeping, Sein – sort, Seiton – set in place, Seiso – shine, Seiketso – standardise, Sitsuke – sustain

ADVANCED TOOLS ARE:

Failure mode and effect analysis: An iterative process to identify at the design stage of new products what could go wrong during manufacturing or during use by the end user. Points examined include: function, potential failure modes, effect of potential failure, review of current controls, determination of risk (likelihood, and severity of effect of failure)

Design of Experiments: Process of examining options during the design stage of a product. Input factors are changed and results of changes to outputs noted.

Design for six sigma: The DMAIC cycle of Define, Measure, Analyse, Improve and Control. This is a continuous feedback and control process.

Our contention is that the prime objective of any organisation is customer satisfaction through the achievement of a consistent and sustainable quality of product. What is provided must be affordable to the organisation, and therefore it is vital, too, that resources be used efficiently. Resources are generally limited in quantity and quality, thus, there are conflicting objectives. In basic terms, make a profit and have satisfied customers. FIT sigma recognises this and provides an approach to determine what the customer really wants and to match resources to essential customer needs. With FIT sigma, we show that it is not essential to meet all customer needs, but by making the best of existing resources to meet key needs.

REFERENCES

- Quality Beyond Six Sigma, Basu and Wright (2004)
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- Implementing Quality, Ron Basu (2004)