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UPSC ENGINEERING SERVICES EXAMINATION

Preliminary Examination

General Studies and Engineering Aptitude

**Standards and Quality Practices in
Production, Construction,
Maintenance and Services**

Comprehensive Theory *with* Practice Questions
and ESE Solved Questions





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Preface

The compilation of this book **Standards and Quality Practices in Production, Construction, Maintenance and Services** was motivated by the desire to provide a concise book which can benefit students to understand the concepts of this specific topic of General Studies and Engineering Aptitude section.



B. Singh (Ex. IES)

This textbook provides all the requirements of the students, i.e. comprehensive coverage of theory, fundamental concepts and objective type questions articulated in a lucid language. The concise presentation will help the readers grasp the theory of this subject with clarity and apply them with ease to solve objective questions quickly. This book not only covers the syllabus of ESE in a holistic manner but is also useful for many other competitive examinations. All the topics are given the emphasis they deserve so that mere reading of the book clarifies all the concepts.

We have put in our sincere efforts to present detailed theory and MCQs without compromising the accuracy of answers. For the interest of the readers, some notes, do you know and interesting facts are given in the comprehensive manner. At the end of each chapter, sets of practice question are given with their keys and detailed explanations, that will allow the readers to evaluate their understanding of the topics and sharpen their question solving skills.

Our team has made their best efforts to remove all possible errors of any kind. Nonetheless, we would highly appreciate and acknowledge if you find and share with us any printing and conceptual errors.

It is impossible to thank all the individuals who helped us, but we would like to sincerely thank all the authors, editors and reviewers for putting in their efforts to publish this book.

With Best Wishes

B. Singh

CMD, MADE EASY Group

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7

Six Sigma

7.1 Historical View

- The term “Six Sigma” was coined by Bill Smith (Father of Six Sigma), an engineering with Motorola.
- Late 1970s – Motorola started experimenting with problem solving through statistical analysis.
- In 1987 – Motorola officially launched it's Six Sigma programme and due to use of six sigma Motorola is known worldwide as a quality leader and a profit leader. The secret of their success became public knowledge after Motorola won the Malcolm Baldrige National Quality Award in 1988.
- In 1991 – Motorola certified it's first 'Black Belt' experts, which indicates the beginning of formalization of the accredited training of six sigma methods.
- In 1995 – six sigma become well known after Mr. Jack Welch made it central focus of his business strategy at General Electric (New York), today it is used in different sector of industry.

7.1.1 What is Sigma?

The term “Sigma” is used to designate the distribution or spread about the mean (average) of any process or procedure. For a process, the sigma capability (z-value) is a metric that indicates how well that process is performing. The higher the sigma, capability will be better. Sigma capability measures the capability of the process to produce defect-free outputs.

“Sigma is used in statistics as a measure to denote the standard variation in process”.

As sigma level increases, cost of poor quality goes down, while profitability, productivity and customer satisfaction go up.

7.1.2 What is Six Sigma?

Six Sigma has been around for more than 20 years and heavily influenced by TQM (Total Quality Management) and Zero Defect principles. In its methodology, it asserts that in order to achieve high quality manufacturing and business processes, continued efforts must be made to reduce variations.

Six sigma is not about establishing a separate quality tower within a company or organization and is also not about cost avoidance.

The idea behind Six sigma is that if you can measure how many “defects” you have in a process you can systematically figure out how to eliminate them and get as close to ‘zero defects’ as possible. It starts with the application of statistical methods for translating information from customers into specifications for products or service being developed or produced.

It is an enterprise wide strategy that effectively develops employee within a company to improve the overall performance of the enterprise from a financial and customer perspective.

It is a highly disciplined process that enables organization to deliver nearly perfect products and services. The increase in performance and decrease in process variation leads to defect reduction and vast improvement in profits, employee morale and quality of product.



Why do we call Six Sigma as Six Sigma and not Four or Five Sigma or Eight Alpha?

Sigma is a statistical term that measures process deviation from process mean or target. Mean is also referred as average in common language. The figure of six was arrived statistically by looking at the current average maturity of most business enterprises.

Six sigma seeks to improve the quality of the output of a process by identifying and removing the cause of defects and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organisation who are experts in these methods.

It is a rigorous and a systematic methodology that utilizes information (management by facts) and statistical analysis to measure and improve a company's operational performance, practices and systems by identifying and preventing 'defects' in manufacturing and service related processes in order to anticipate and exceed expectations of all stakeholders to accomplish effectiveness.

Note: Six sigma is not a standard or certification or another metric like percentage. Rather! It is a quality philosophy and the way of improving performance by knowing where you are and where you could be.

7.1.3 Benefits of Six Sigma

Six sigma emerged as a natural evolution in business to increase profit by eliminating defects (A defect is any incident or event which fails to meet the customer expectations). By aiming processes at six sigma there would not be more than 3.4 defects per one million opportunities. Then processes can be evaluated to reach a target level with upper and lower limits. In order to reach these limits, the process variation will have to be reduced. Then as a result of which the curve will become more peaked.

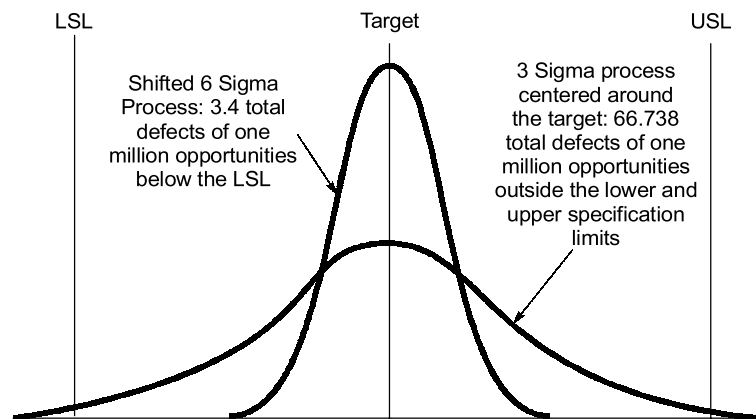


Fig. 7.1

Note: The goal of Six Sigma is to increase profits by eliminating variability, defects and waste that undermine customer loyalty.

Applications of Six Sigma:

Its usage depends on the type of business. In general, "If there are processes that generate a lot of negative feedback, whether that customer is internal or external, the components of six sigma should be considered as a means to study and rectify the problem.

Six sigma mostly finds application in large organisation included manufacturing engineering and construction, finance supply chain and healthcare etc.

Within any organisation, six sigma:

1. Generates sustained success
2. Sets performance goal for everyone
3. Enhances value for customers
4. Accelerates rate of improvement
5. Promotes learning across boundaries
6. Execute strategic change

- **The Executive Leader** must be committed to this program and provide the leadership both to promote team work and collaboration among all the players in the program. In order to do this, they must be knowledgeable in the Six Sigma process and assign valued, committed individuals into the Champion/Sponsor positions.
- **The Champion/Sponsor** decides what needs to be done and provides the assistance to the Black Belts both with monetary resources as well as dedicated staff. In addition, this position benchmarks with other organizations in order to gain key information in processes they may need to improve. Champion play a pivotal role in that they own the processes of the business and, therefore, must ensure process improvements are captured and sustained.
- **The master, or master black belt** is a person who is at the highest level of expertise on the subject. They are fully devoted to the process and have no other job responsibilities outside the methodology. They are involved in every aspect of training and monitoring of all of the lower belt ranks.
Example : Instructors, coaches, technical leaders.
- **A certified Black Belt** exhibits team leadership, understands team dynamics, and assigns their team members with roles and responsibilities. They have a complete understanding of the DMAIC model in accordance with the Six Sigma principles, have a basic knowledge of lean enterprise concepts, and they can quickly identify “non-value-added” activities. Black Belts primarily focus on project execution, whereas Champions and Master Black Belts focus on identifying projects and functions for Six Sigma. Example -project team leaders and team members.
- **Green Belt** has emphasis on the DMAIC (Define, Measure, Analyze, Improve and Control) model. Six Sigma Green Belt certification helps the employee serve as a trained team member within his or her function-specific area of the organization. This focus allows the Green Belt to work on small, carefully defined Six Sigma projects, requiring less than a Black Belt’s full-time commitment to Six Sigma throughout the organization. Example – project team members, temporary team members.

7.4 Future of Six Sigma - Lean Concepts

Methodologies to implement lean

1. Understanding customer value.
2. Value stream analysis-analyse to determine which one actually add value.
3. Flow-focus on organizing a continuous flow through the production or supply chain rather than moving commodities in larger batch sizes.
4. Pull-prevents stock.
5. Perfection-elimination of non-value adding elements (waste) is a process of continuous improvement.
6. Six Sigma + Lean = Lean six sigma.

Note: The focus of lean is about speed, efficiency and taking waste out of a process where as six sigma focuses on effectiveness and removal of errors.

Previous ESE Prelims Questions

- Q.1** Consider the following statements with reference to six-sigma.
1. It is a set of techniques and tool for process improvement.
 2. It postulates that any process must not produce more than 3.4 defects per one million opportunities.
 3. It is an initiative of Motorola.

Which of the above statements are correct:

- | | |
|------------------|---------------------|
| (a) Only 1 and 2 | (b) Only 1 and 3 |
| (c) Only 2 and 3 | (d) Only 1, 2 and 3 |

[ESE-2018]

Ans. (d)



Objective Brain Teasers

- Q.1 Statement-I:** Six Sigma is a standard certification.
Statement-II: Sigma is a statistical term that measures process deviation.
 Which of the above statement is/are correct:
 (a) Only statement I
 (b) Only statement II
 (c) Both statement I and statement II
 (d) Neither statement I not statement II
- Q.2** Six Sigma gives a precision of:
 (a) 95.45% (b) 99.73%
 (c) 99.99% (d) 68.27%
- Q.3** Match the following:
List-I
 A. Master black belt
 B. Green belt
 C. Yellow belt
 D. Black belt
List-II
 1. Highest expertise on subject
 2. Understand DMAIC
 3. Trained team members
 4. Team member
Codes:

	A	B	C	D
(a)	1	4	3	2
(b)	1	2	3	4
(c)	1	2	4	3
(d)	1	3	4	2
- Q.4** As sigma level increases:
 (a) Cost of poor quality and customer satisfaction both go up.
 (b) Cost of poor quality go up and customer satisfaction go down.
 (c) Cost of poor quality go down and customer satisfaction go up.
 (d) Cost of poor quality and customer satisfaction both go down.
- Q.5** DMADV is used instead of DMAIC when:
 (a) Demands of customers with regard to quality can not be satisfied by existing process.
 (b) To make improvements far achieving ISO certificate.
 (c) To reduce defects and repair time.
 (d) To increase quality standards.
- Q.6** Which of the following is key objective of a six sigma project?
 (a) Developing detailed control charts for critical processes.
 (b) Developing a matrix to understand the how's and what's of a problem process.
 (c) Reduce variation in critical processes.
 (d) Reducing investment costs while improving output quality.
- Q.7** The quantity sigma indicates:
 (a) Average (b) Dispersion
 (c) Range (d) Modulus
- Q.8** Analyse phase includes:
 (a) Identify vital project and statistically validate them.
 (b) Communicate and sign off to close project.
 (c) Generate potential solutions and assess failure mode.
 (d) All of the above
- Q.9** DMADV refers to
 (a) design of new products
 (b) improvement of existing process
 (c) ISO 9000:2000 certification
 (d) the Baldrige Quality Award
- Q.10 Statement (I):** In order to decrease defective parts, we need to decrease sigma value.
Statement (II): As the value of sigma decreases, more number of observations are flushed around the mean and lesser will be number of defective.
- Q.11** Six Sigma implies
 (a) A statistical method
 (b) A troubleshooting method
 (c) Teams are effective
 (d) 3.4 defects per million in output
- Q.12** The major purpose of the control phase in DMAIC is to
 (a) identify root cause
 (b) determine long term solution

- (c) maintain the gain made with implemented solution
 (d) calculate c_p and c_{pk}

Q.13 In six sigma approach, what is the name given to experts in the use of six sigma tools and techniques as well as how such tools can be used and implemented?

- (a) Master black belt (b) Master green belt
 (c) Black belt (d) Green belt

Q.14 DMAIC is

- (a) Quality control tool
 (b) Process improvement methodology
 (c) Given by W. Edward Deming
 (d) Used for new process

Q.15 In six sigma when Black Belt training has been completed, employees are able to

1. Develop, coach and lead cross-functional teams.
2. Achieve results that match the company's business strategies with a positive benefits to financial performance.

Which of the above is/are correct?

- (a) 1 only (b) 2 only
 (c) 1 and 2 (d) None

Q.16 Which of the following is/are correct for six sigma.

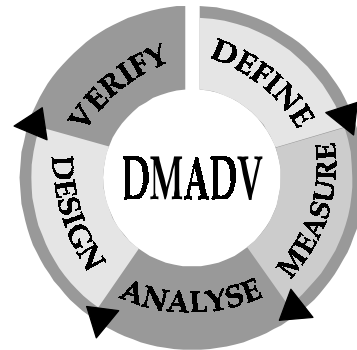
1. Motorola by Bill Smith.
 2. 3.4 defects per million.
 3. 99.99966% long term yield.
- (a) 1 and 2 only (b) 2 and 3 only
 (c) 1, 2 and 3 (d) None

Answers

1. (b) 2. (c) 3. (d) 4. (c) 5. (a)
 6. (c) 7. (b) 8. (a) 9. (a) 10. (a)
 11. (d) 12. (c) 13. (a) 14. (b) 15. (c)
 16. (c)

Explanations

9. (a)



DMADV is a six sigma framework that is focuses primarily on the development of a new service or new product.

