

PART 1

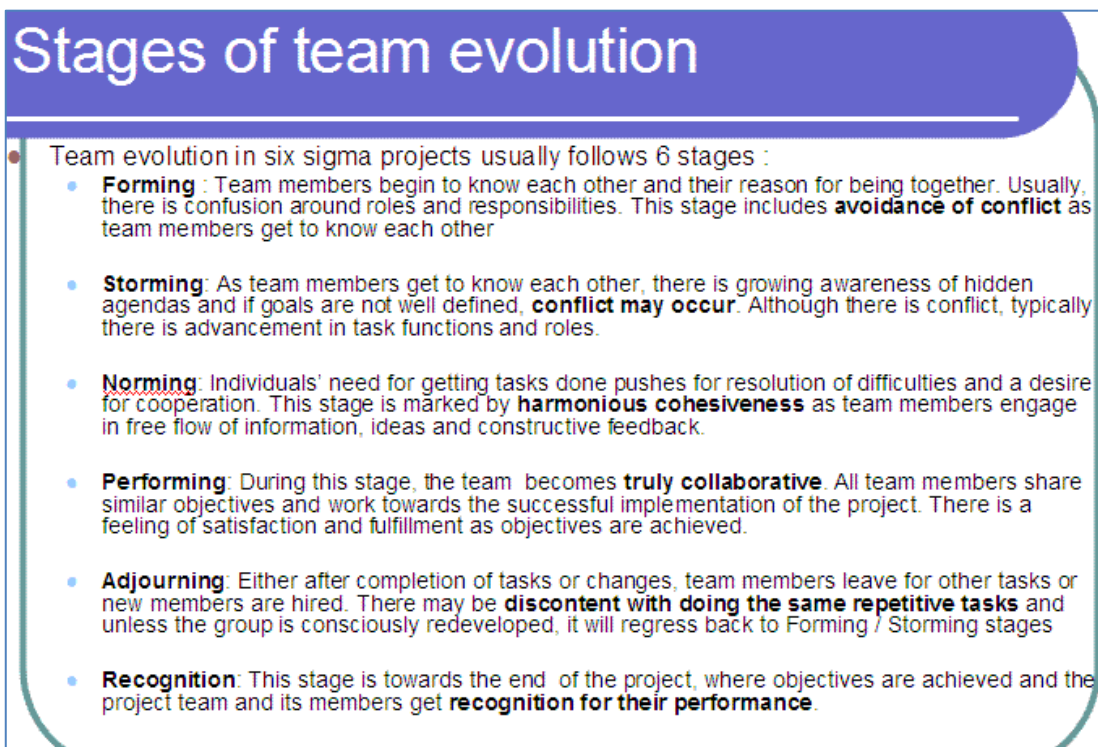
Q.1 George sets up a kick-off meeting with the core team members. In the meeting, what kind of behavior would you expect from team members?

1. Conflict avoidance since team members are just getting to know one another
2. Lots of conflict with issues
3. Cohesiveness as the team engages in free flow of information and sharing ideas
4. Discontent with repetitive tasks

Ans: 1

Justification:

Since the group is in forming stage, team members begin to know each other and their reason for being together. Usually, there is confusion around roles and responsibilities. This stage includes avoidance of conflict as team members get to know each other.



The diagram is titled "Stages of team evolution" in a large, white, sans-serif font on a dark blue background. Below the title, a list of six stages is presented, each preceded by a blue circular bullet point. The stages are: Forming, Storming, Norming, Performing, Adjourning, and Recognition. Each stage is followed by a detailed description of the team's behavior and dynamics during that phase. The text is in a smaller, black, sans-serif font.

Stages of team evolution

- Team evolution in six sigma projects usually follows 6 stages :
 - **Forming** : Team members begin to know each other and their reason for being together. Usually, there is confusion around roles and responsibilities. This stage includes **avoidance of conflict** as team members get to know each other
 - **Storming** : As team members get to know each other, there is growing awareness of hidden agendas and if goals are not well defined, **conflict may occur**. Although there is conflict, typically there is advancement in task functions and roles.
 - **Norming** : Individuals' need for getting tasks done pushes for resolution of difficulties and a desire for cooperation. This stage is marked by **harmonious cohesiveness** as team members engage in free flow of information, ideas and constructive feedback.
 - **Performing** : During this stage, the team becomes **truly collaborative**. All team members share similar objectives and work towards the successful implementation of the project. There is a feeling of satisfaction and fulfillment as objectives are achieved.
 - **Adjourning** : Either after completion of tasks or changes, team members leave for other tasks or new members are hired. There may be **discontent with doing the same repetitive tasks** and unless the group is consciously redeveloped, it will regress back to Forming / Storming stages
 - **Recognition** : This stage is towards the end of the project, where objectives are achieved and the project team and its members get **recognition for their performance**.

Q.2 In a subsequent meeting, Linda Hill, the marketing executive, makes a statement that the manufacturing department has not been producing as per specifications and is therefore largely responsible for the customer complaints. Christopher Payne, the shop floor technician, disagrees with Linda's statement and they start quarrelling over the issue. You understand that this kind of discussion is counter-productive, so you decide to use which of the following techniques to handle the conflict?

1. Withdrawal
2. Smoothing
3. Forcing
4. Do not intervene and let them argue out the issue

Ans: 2

Justification:

At this stage, Smoothing is the best conflict handling technique to be used. You should emphasize that since both Linda and Christopher were working in the company, it was their combined responsibility to find resolution for this issue. Moreover, by following the six sigma methodology, quantifiable and actionable solutions would be found which would resolve the issue.

Handling Conflicts

- Blake and Mouton have delineated five modes for handling conflicts:
- **Withdrawal:** retreating or withdrawing from a potential disagreement.
- **Smoothing:** de-emphasizing or avoiding areas of differences and emphasizing areas of agreement.
- **Compromising:** bargaining and searching for solutions that bring some degree of satisfaction to the parties in a dispute. Characterized by a "give and take" attitude.
- **Forcing:** exerting one's viewpoint at the potential expense of another. Often characterized by competitiveness and a win-lose situation.
- **Confrontation:** facing the conflict directly, which involves a problem solving approach whereby affected parties work through their disagreements.

Q.3 One of the first tasks identified is to create a graphic representation of the relevant processes in the company showing the sequence of tasks performed and their relationships. This is referred to as a:

1. Process Map
2. Problem Statement
3. Pareto Chart
4. None of the above

Ans: 1

Justification:

Process maps give a view of how work flows through the company. It is a graphic representation of processes in a company showing the sequence of tasks performed and their relationships.

Q.4 You understand the importance of generating ideas which can be helpful in finding a solution. Which of the following tools would you NOT use to do this?

1. Surveys
2. Focus Groups
3. Brainstorming
4. Affinity Diagram

Ans: 4

Justification:

Affinity diagrams (covered in Chapter 3: setting up and managing a six sigma project) are important tools for idea categorization, not idea generation.

Q.5 You decide that you would like to use brainstorming to get ideas from the team about the issues. In the brainstorming session,

1. Every individual on the team is asked to think creatively and write down as many ideas as possible. A facilitator coordinates the brainstorming session and ensures that all individuals are allowed to discuss their ideas.
2. Different stakeholders' goals are measured quantitatively and translated into metrics.
3. you create a questionnaire which is filled in by all the participants
4. threshold, performance, and attractive attributes are determined

Ans: 1

Justification:

Steps followed in brainstorming:

Topic selection: An appropriate topic is selected for the brainstorming session.

Idea generation: Every individual in the team is asked to think creatively and write down as many ideas as possible.

Regroup ideas: A facilitator coordinates a brainstorming session where all individuals are allowed to discuss their ideas. Inputs from all individuals are captured on a board which everyone can review. Proper care is taken to ensure that there is no criticism of any ideas and everyone is allowed to be creative. Also, no one person or group of persons are allowed to dominate the discussion

Validation: Methods like Multivoting (discussed later) are used to validate and rank the ideas generated.

Q.6 There appears to be several factors which are responsible for the spherical bearings not meeting specifications. You know that usually a small number of causes are responsible for a large number of the effects. So, you ask Christopher Payne to coordinate a study to determine the most important causes of the problems. The tool that Christopher would use is called:

1. Multi-voting
2. Pareto Chart
3. Brainstorming
4. Quality Function Deployment

Ans: 2

Justification:

Pareto chart is based on the Pareto principle (also referred to as 80-20 rule), which states that a small number of causes (20%) is responsible for a large percentage (80%) of the effect

In a six sigma project, there are several available opportunities which can be followed to attain the project objectives. Pareto chart helps in identifying and ranking which of the opportunities would yield maximum benefits and hence should be pursued first.

Q.7 You decide that a Focus Group with some key customers would be beneficial as it would help the team to understand what customers think of the product and maybe get some ideas about potential new features. Since Linda Hill interacts daily with customers, you and George ask her to coordinate a Focus Group session. How many people would you ideally want to have in this group?

1. Less than 5
2. 7
3. 11
4. More than 13

Ans: 2

Justification:

Focus group is a powerful method to evaluate existing product and get new ideas. A focus group usually consists of 6-10 people selected from a group because of some common characteristics as required for the focus group (e.g. a focus group of users of a particular brand of TV could be used to evaluate the current product and get ideas about what new features the customers would like to have).

Q.8 As a facilitator in the Focus Group discussion, your main objective would be to:

1. create an environment which fosters conflict and surfaces hidden issues
2. create an environment which allows for free flow of information and also ensures that appropriate questions get discussed and answered
3. allow the more influential customers more time to speak in the discussion because they are very important to the company
4. None of the above

Ans: 2

Justification:

The facilitator plays a very important role in the focus group – she creates an environment which allows for free flow of information and also ensures that appropriate questions get discussed and answered. She also ensures that everyone in the group gets to voice their opinions and suggestions. Also, additional clarification can be got on issues which are important from the company's perspective.

Q.9 After the Focus Group discussion, you spend some time with the customers trying to determine product characteristics including threshold, performance, and attractive attributes. Which technique would you use to capture this information?

1. NGT
2. Kano Model
3. QFD
4. Surveys

Ans: 2

Justification:

- Developed by Professor Noriaki Kano, the Kano Model is very effective in differentiating between the different attributes of a product from a customer perspective. Inputs from the Kano Model are very valuable for a design team to understand customer requirements and aspirations.

- Kano classified product characteristics into three categories:

- **Threshold/Basic Attributes:** Attributes which are considered basic or intrinsic to the product. Customers would assume these attributes to be present in the

product – so, non-availability of these attributes would be a dis-satisfier. However, customers will continue to remain indifferent if these attributes are available

- **Performance Attributes:** Attributes which are directly proportional to customer satisfaction. Increased availability of these features improves customer satisfaction; decreased availability results in greater dissatisfaction
- **Attractive Attributes:** These are features from which customer gets excited or delighted and hence are ready to pay a premium. At most times, customers would not know these attractive attributes since they may be driven by innovation and cutting edge technology which customers may not be familiar with.

Q.10 At this point in time, you have some idea of customer needs from the information gathered during the Focus Group discussions and use of the Kano Model. The team has also brainstormed for ideas and used Process Maps and Pareto Charts to get a better understanding of the issues. Based on the team's analysis and input, you have determined that the most important issue to be addressed is variation in the size of the ball bearings. This is an example of:

1. COPQ
2. Primary Metric
3. Consequential Metric
4. Problem Statement

Ans: 2

Justification:

Metrics can be broadly categorized into:

- Primary metrics –measures which the six sigma project primarily targets to achieve e.g. for a particular project, reduction in cycle time could be a primary metric
- Consequential metrics – while trying to achieve the goals set forth by primary metrics, there may be some additional metrics which may be impacted. These are referred to as consequential metrics e.g. for a particular project where reduction in cycle time is the primary metric, there may be added advantages e.g. reduction in defect rate and improvement in perceived quality by the customer – so, these are consequential metrics of the project.

PART - 2

Q.1 The primary metric you would like to investigate in your Six Sigma project is the size of the spherical balls. The diameter of each ball is measured and reported in inches. You understand that diameter measurement in this case is:

1. Discrete data
2. Continuous data
3. COPQ data
4. None of the above

Ans: 2

Justification:

Diameter of the ball can be measured on a continuum or scale. Hence it is continuous data

Q.2 If you were to measure the diameter of the balls for comparison purposes, which type of scale would you use?

1. Nominal
2. Ordinal
3. Interval
4. Ratio

Ans: 4

Justification:

In ratio scale, the scale consists not only of equidistant points but also has a meaningful zero point. If we ask respondents their ages, the difference between any two years would always be the same, and "zero" signifies the absence of age or birth. Hence, a 100-year old person is indeed twice as old as a 50-year old one.

Q.3 You understand the importance of measuring the variation in the measurement system. This is because you know that total variation in a system is the:

1. Sum of Process Variation and Measurement System variation
2. Difference of Process Variation and Measurement System variation
3. Sum of Special Cause and Common Cause variation
4. Sum of Expected Variation and variation due to change in process

Ans: 1

Justification:

Total variation in a system is the sum of process variation and measurement system variation

Q.4 In the Gauge R&R study, with Christopher's help, you ask three operators to do two trials each of twenty-five balls and record their measurements. The overall accuracy is 95% and the reliability of operators is close to 96%. What do you infer from the study?

1. The measurement system is accurate enough for the purpose
2. The measurement system has good stability
3. More training is required for the operators since reliability is low
4. Another measurement system needs to be defined to measure the observations

Ans: 1

Justification:

The overall accuracy is 95% : which is high enough to show that the current measurement system is valid for our purpose.

Q.5 Which of the following describes entitlement cost?

1. Cost incurred due to rework
2. Cost incurred due to warranty and other insurance
3. Cost of producing goods correctly the first time
4. Cost incurred when labor and materials are scrapped

Ans: 3

Justification:

From a process perspective, process costs are divided into 2 high level categories:

Entitlement costs: These are costs associated with producing goods correctly the first time.

Cost of Poor Quality (COPQ): These are costs associated with not performing work correctly the first time and with producing low quality goods (e.g. internal failure costs - reworking and retesting to correct defects, higher inventory, external failure costs - warranties and other insurance).

Q.6 As a result of the QFD study, you will get a:

1. House of Quality
2. Run Chart
3. Special and Common Cause of variation
4. Customer Attributes Matrix

Ans: 1

Justification:

QFD is usually carried out by a cross-functional group of individuals who are tasked with developing a new product or refining an existing one. The result of a QFD analysis is called "house of quality" which is a set of matrices which provide direction

to the company about which features or attributes should be implemented in the product.

Q.7 With the help of the Six Sigma Black Belt, Peggy, you calculate the baseline process capability. Indices used by Peggy for this purpose are:

1. Cp and Cpk
2. Pp and Ppk
3. Cpm and Ppm
4. None of the above

Ans: 1

Justification:

In a six sigma Black Belt course, Process capability would be measured using indices like (Cp and Cpk). Process performance would be measured using indices like Pp, Ppk and Cpm : this is beyond the scope of a six sigma Green Belt course.

Q.8 The team is now nearing the end of the *Measure* phase of the project. You ascertained the accuracy of the measurement system using a Gauge R&R study and created a Run Chart to do some preliminary analysis of data using a continuous scale. QFD was used to map the Voice of the Customer to internal company processes and also provide competitive evaluation. Baseline process capability was determined by Peggy and the Cost of Poor Quality (COPQ) was calculated. All the following are outputs from the *Measure* phase of Six Sigma EXCEPT:

1. Well-defined processes
2. Baseline process capability
3. Process parameters affecting CTQ
4. Validation techniques

Ans: 4

Justification:

Validation Techniques are tools used in six sigma methodology (measure)

Q.9 After completion of the *Measure* phase, the team moves into the *Analyze* phase. Which of the following are objectives of the *Analyze* phase?

1. Analyzing whether the present system can be further improved
2. Determining the failure points for the proposed changes
3. Analyzing how the process capability would improve if suggested changes are made
4. All of the above

Ans: 4

Justification:

In Analyze phase, our objectives are:

- Doing analysis of present system
- Analyzing whether the present system can be further improved
- Determining the failure points for the proposed changes
- Determining major milestones and risks in successfully completing the project
- Analyzing how the process capability would improve if suggested changes are made.

Q.10 Now, you would like to create a graphical representation of possible causes for any particular problem under study to clarify the understanding the team has regarding the process. This can be achieved using which of the following tool:

1. Ishikawa diagram
2. Pareto Chart
3. Process Map
4. QFD

Ans: 1

Justification:

Developed by Kaoru Ishikawa in 1960's, Ishikawa diagram is a graphic representation of possible causes for any particular problem under study. Benefits of Ishikawa diagrams

- Usually created by a group of people who have knowledge of the process and understand the problems in the present system. Is a very powerful tool to organize and graphically display all the knowledge the team has about a particular problem
- Clarifies the understanding the team has regarding the process. If an Ishikawa diagram does not show appropriate level of detail, it indicates that the team has a superficial knowledge of the problem. Hence, additional study of the system or involvement of Subject Matter Experts is required.
- Is a starting point to determine the Vital X's that impact the customer's critical to quality variable : Y. (Details about Y and Vital X's as defined in the chapter 2: Stakeholders, customers and financial measures)

PART - 3

- Q.1 Which of the following describes the objective(s) of the *Improve* phase of Six Sigma methodology?
1. Determine which project would be selected to maximize the Return on Investment (ROI)
 2. Find out cause and effect relationships using tools like Design of Experiments (DOE) and a Solutions Matrix which would help in comparison and verification of alternate solutions
 3. Determine how to reintegrate the different subprojects
 4. All of the above

Ans: 4

Justification:

In Improve phase, our objectives are:

- Determine which project would be selected that maximizes the Return on Investment (ROI)
- Find out cause and effect relationships using tools like Design of Experiments (DOE) and Solutions Matrix. This helps in comparison and verification of alternate solutions.
- Determining activities needed to meet project goals.
- Creating work breakdown structures and detailed implementation plan for the project.
- Determining how to re-integrate the different sub-projects.

- Q.2 After the *Analyze* phase of the Six Sigma project, you have determined several alternatives which will help in achieving the objective of managing variation in the size of the spherical bearings. To measure how effectively the company uses its capital to generate profit, you should use:
1. Return on Investment (ROI)
 2. Return on Capital Employed (ROCE)
 3. Net Present Value (NPV)
 4. Internal Rate of Return (IRR)

Ans: 1

Justification:

ROI (Return on Investment) is a measure of the income (or profit) divided by investment. ROI measures how effectively the company uses its capital to generate profits

Q.3 From a Six Sigma project perspective, Return on Investment (ROI) is calculated as the:

1. Ratio of project cost to project benefit
2. Ratio of project benefit to project cost
3. Product of project cost and project benefit
4. None of the above

Ans: 2

Justification:

From a six sigma project perspective, the project cost is the investment, and income is the quantified benefits accrued from the project. So, ROI for a six sigma project is the ratio of project benefits to project costs.

Q.4 To verify proposed solutions and ensure that the company realizes the benefits from doing the Six Sigma project, the team would like to compare how the proposed solutions compare with the existing system in meeting the specified criteria. This can be done using:

1. Kano Model
2. QFD
3. Solution Design Matrix
4. ROI

Ans: 3

Justification:

Solution Design Matrix is a tool to organize alternate solutions based on information available. It helps to compare the proposed solutions with the existing system to find out how the proposed solutions meet the specified criteria.

Q.5 In Design of Experiments, the setting or category that a variable may take is referred to as:

1. Factor
2. Level
3. Trial
4. Response variable

Ans: 2

Justification:

Levels: Setting or category that a variable may take. Two or more levels could be chosen for each category

Q.6 In conducting Design of Experiments, Peggy studies only some of the possible factors and levels simultaneously. This is an example of a:

1. One factorial design
2. Two factorial design
3. Fractional factorial design
4. Full factorial experiment

Ans: 3

Justification:

Fractional factorial experiment: Only some of the possible factors and levels are studied simultaneously

Q.7 In the *Improve* phase of a Six Sigma project, the team should have a good idea about the project management tools that can be used to ensure that appropriate project planning is done. Project planning includes a detailed implementation plan. As per the Project Management Institute (PMI), all of the following are project management knowledge areas EXCEPT:

1. Project Time Management
2. Project Procurement Management
3. Project Escalation Management
4. Project Quality Management

Ans: 3

Justification:

Fractional factorial experiment: Only some of the possible factors and levels are studied simultaneously

Q.8 Since the solution suggested is complex, you recommend a small scale working model which provides an idea of the final product. This is an example of:

1. 3D Modeling
2. RSM
3. Prototype
4. None of the above

Ans: 3

Justification:

As defined in Webster, "prototype is an original or model after which anything is copied." From a six sigma project perspective, prototype is a small scale working model which provides idea of the final product, process or service

Q.9 Which of the following are objectives of the *Control* phase of a Six Sigma project?

1. To control project management parameters such as risk, cost, scope, schedule, quality, and changes
2. To measure the gains made by the project using tools like Statistical Process Control and Control Charts
3. To ensure that gains made by the project are sustained
4. All of the above

Ans: 4

Justification:

In Control phase, our objectives are:

- Control project management parameters including risk, cost, scope, schedule, quality, changes etc
- Measure the gains made by the project through Statistical Process Control, Control charts etc.
- Ensure that the targets set by the project are achieved.
- Ensure that gains made by the project are sustained

Q.10 In the *Control* phase, one of the first things you do is to create a systematic methodology to develop a data collection strategy. The methodology includes information about product and process characteristics. It states the control methods to be used, data to be collected, and steps to be taken if problems are detected. The tool you will use for this is called a:

1. Run Chart
2. Control Plan
3. Control Chart
4. Pareto Chart

Ans: 2

Justification:

Control Plan:

- Created during the Control phase of a six sigma project, the control plan is a systematic methodology to develop a data collection strategy for the process.
- Contains information about product and process characteristics. It states the control methods to be used, data to be collected and steps to be taken if problems are detected.