

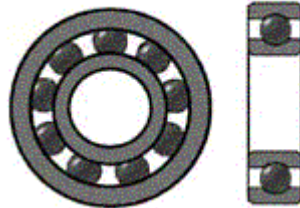
CASE STUDY Questions



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Part 1

Your company, ABC Bearings, manufactures spherical bearings used in ball bearing assemblies. The bearings are supplied primarily to automobile manufacturing companies. A sample ball bearing assembly has 9 identically shaped balls as shown:



Recently, there have been multiple complaints from several customers regarding the quality of some of the ball bearing shipments they received. The company Vice President, Elizabeth Townsend, is quite concerned and is determined to find out the reasons behind the complaints. She intends to get to the bottom of the issues and then have those resolved using Six Sigma methodology. Accordingly, Elizabeth has put together a core project team who will use Six Sigma methodology to identify the problem areas and suggest improvements.

The core team members include:

- *George Roth*: George is responsible for the project deliverables and for creating and managing the project plan.
- *Christopher Payne*: Christopher is one of the shop floor technicians involved in the ball bearings manufacturing process.
- *Linda Hill*: Linda is a marketing executive who interacts with customers on a daily basis.
- *Peggy Lamp*: Peggy is a Six Sigma Black Belt. Peggy will not play a lead role on this project, but she is available to provide expert assistance with Six Sigma methodology on this as required.
- *You*: You are a Six Sigma Green Belt and the lead Quality expert. You will lead and guide the team through the Six Sigma methodology.

Elizabeth has approved high-level funding for the project and has promised to commit additional resources, if required. She has also made it clear to the core team that the project is of great importance to the company; if assistance is required from other areas of the company, she will coordinate to ensure that representatives from the respective groups are made available.

- 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
- 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
- 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
- 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
- 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

- 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
- 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
- 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
- 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
- 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

Part 2

You have successfully completed the *Define* phase of your Six Sigma project. Brainstorming, multi-voting, high-level Process Maps, and Pareto Charts were used to discuss the problem within your organization. Customer input was received through the use of Focus Groups and the Kano Model. Based on the input received by the project team, the Project Charter was finalized, a Roles and Responsibilities Matrix was created, and the Problem Statement was defined. It was decided that the primary metric is to address variation in the size of the spherical bearings. Consequential metrics include improvement in customer satisfaction and reduction in cycle time.

- 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
- 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
- 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
- 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
- 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
- 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

- 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
- 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
- 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
- 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

Part 3

In the *Measure* phase of your Six Sigma project, you validated the measurement systems using a Gauge R&R study, created a Run Chart, and conducted a QFD study to map the Voice of the Customer to internal company processes and also provide a competitive evaluation. You calculated the Cost of Poor Quality (COPQ) and measured the baseline process capability.

In the *Analyze* phase, you created an Ishikawa Diagram as a graphical representation of possible causes for the particular problem under study and determined the Vital X's that impact the customer's critical to quality variable, Y. A Failure Mode and Effects Analysis (FMEA) was conducted to identify methods to eliminate or reduce the chances of failure occurring. This was followed by hypothesis testing where the black belt expert, Peggy Lamp, helped the team to determine the confidence level as to whether the inference being made concerning a small sample would apply to the whole population. The DPMO level was found to be 67000 which indicated a level of 3 sigma for your application.

- 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
- 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)
- 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
- 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
- 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

- 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
- 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
- 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
- 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
- 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

