Six Sigma Green Belt - Study Guides

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Identifying Stakeholders

Stakeholders: Project stakeholders are **individuals** and **organizations** that are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or project completion; they may exert influence over the project and its results. – PMBOK 2000 Page 16

Most important stakeholders for a Six Sigma project are:

- Project Manager
- Team members
- Project sponsor
- Customer
- End users
- Shareholders

Balanced Scorecard – Balancing Needs of all Stakeholders

- It is extremely important to balance the needs of all stakeholders. Usually stakeholders have conflicting needs and focusing too much on any particular group may be detrimental to the needs of all other stakeholders. Some examples:
    - Too much emphasis on decreasing costs may mean short term increase in margins and profitability, but in the long term may result in lower quality.
    - Concentrating only on increasing shareholders value and share-price in the short term may result in the company losing sight of long-term goals e.g. loss of market share and customers.
- Balanced scorecard is a tool used to measure different stakeholders' goals quantitatively and translate these goals into metrics.

Balanced Scorecard – Balancing Needs of all Stakeholders (continued)

- Steps used:
  - Balanced scorecard begins with determining the vision and strategy for of the organization. This forms the basis for each balanced scorecard.
  - For each stakeholder, important metrics are then determined by experienced black belts and master black belts. For this, we create a dashboard which displays the metrics for the stakeholder. Each of the results (also referred to as “Ys”) of the metric are caused by specific effects (also referred to as “Xs”).
  - Let us consider Customer Satisfaction may be a metric on a top level dashboard which we want to aim for. So, this is a potential result (Y). Customer Satisfaction can be obtained through several effects (i.e. “Xs”) e.g. through decreasing defects, improving customer service, improving quality and better brand recognition.
  - Hence, Customer Satisfaction (results - Y) is achieved through a combination of effects - Xs.
- In mathematical parlance, this is referred to as **Y = f(X)** or the result Y is a function of several effects i.e. Xs
- The process of using balanced scorecard is progressively elaborated i.e. we start with a high level Y and work our way down to lower level metrics. Example in next page…

Balanced Scorecard – example of Progressive Elaboration

Y = Improve Customer Satisfaction

- Better Quality (X_1)
- Lower Cost (X_2)

$Y = f(X_1 , X_2)$

i.e. improving customer satisfaction is a function of better quality and lower cost

Y_1 = Better Quality

- Manufacturing better product (X_{11})
- Better Customer Service (X_{12})

$Y_1 = f(X_{11} , X_{12})$

i.e. providing better quality is a function of manufacturing better product and better customer service

Y_{11} = Manufacturing Better Product

- Reducing Defects (X_{111})
- Providing additional features (X_{112})

$Y_{11} = f(X_{111} , X_{112})$

i.e. manufacturing better product is a function of reducing defects and providing additional features

Here, we see an example of how a high level effect (i.e. Y – Improving customer satisfaction) is progressively broken down till we reach the low level causes (e.g. reducing defects – X_{111})

Benefits of Balanced Scorecard

- Very effective tool for getting inputs from different stakeholders, and ensuring that it aligns with the strategy and vision of the company.
- Helpful in project selection where inputs from all stakeholders ensure that no particular group gets undue advantage in the project selection process.
- Helps to quantify very high level objectives or results (i.e “Ys”) in terms of measurable effects (i.e. “Xs”), thus enabling management to make a more informed decision in the project selection process.
- Please note: Detailed study of balanced scorecard will be covered in a Black Belt course; however, the high level understanding of balanced scorecard will help in understanding concepts of Six Sigma required for this Green Belt course.

Determining Critical Vital Xs

- When working with Six Sigma, our objective should be to find the critical effects which will have maximum impact on improving the objectives or results.

- In the balanced scorecard terminology we discussed earlier, the critical effects are also referred to as “Vital Xs” in the balanced scorecard. These are the effects which, if improved, will have a significant effect on the results i.e. the “Y variable.”

- Quantitative discussions about determining the Vital Xs will be covered in a Six Sigma Black Belt course. However, understanding the concept of balanced scorecard and Vital Xs will be very helpful for a Six Sigma Green Belt.

Voice of the Customer

- The customer is the most important stakeholder for any company, and so it is extremely important to understand the customer needs and aspirations. Voice of the customer refers to the stated or unstated needs of the customer, which should be understood very well before designing any product or service. There are 3 steps that need to be followed to understand the voice of the customer:

- Identify the customer

- Collect and analyze customer data

- Determine critical requirements

Identify the Customer; Calculate the Value of Customer Loyalty

- Identification and proper segmentation of the customer can begin through the analysis of existing customers. Some facts to know about the customers include age, gender, living habits, income levels, education level, past buying history etc. Companies keep details of customers who buy their product or service, which can be a starting point in identifying and segmenting customers.

- For any Six Sigma project, the customers may be classified as:

    - Internal i.e. within the same organization (e.g. a technology group within the company that provides support to customer service representatives within the same organization)

    - External i.e. outside the organization (e.g. customers who finally buy a car produced by the company).

Identify the Customer; Calculate the Value of Customer Loyalty (continued)

- **Customer Loyalty:** Getting new customers is usually a very expensive process. Hence, once customers are identified, it is important to try to retain existing customers . Calculating the financial values of customer loyalty helps to identify how much a customer is really worth and hence determine the amount of money which should be spent on retaining customers. To calculate the financial value of customer loyalty, one should consider the total sales that can be expected over a period of time.

- For example, Walmart Inc, the leading stores chain in the world places a very high value on customer loyalty, and identifies customers from small children till the time they die. To ensure that customers continue to be loyal to Walmart, it endeavors to keep prices low and provide an appealing selection. Providing friendly service is extremely important, and there are friendly greeters at the front of every store. “Refund with a smile” policy helps ensure that customers who did not like any product can return it without hassle, and encourages them to continue buying from Walmart. The increased customer focus definitely results in increased costs – but for Walmart, these increased costs are more than compensated by the financial benefits of long term customer loyalty.

Data Collection and Analysis

- Six Sigma is a quantitative methodology where several quantitative metrics (e.g. customer satisfaction, retention, acquisition, repeat sales, market share, employee retention, skills, training, morale, and availability of information required for front line employees etc.) are used. If data collected is not proper, it will lead to wrong interpretation and analysis – thus the Six Sigma project would not deliver the desired results and at times could even deliver non-desirable outcomes. Since very critical decisions are based on the data that is available, proper data collection and analysis are crucial to ensure successful selection and implementation of a Six Sigma project.

- From where can data be available and how are data collected? Data can be available from several sources and collected using several data collection techniques:

Data Collection and Analysis (continued)

Source of Data	Examples of data available	Examples of data collection Techniques
External Environment and competitors	Market Share, Growth in market, Product features etc.	Publications, Comparative study of competitors' products etc.
Financials	Sales, Profit, Growth, Return on Capital employed etc.	Company financials, Balance Sheet, Profit & Loss Statements etc.
Company processes	Defects per million, cycle time etc.	Measurement of internal processes etc.
Customers	Customer Satisfaction, Customer Perception etc.	Surveys, Focus Groups, Interviews, Observations etc.

Data Types

- Data can be broadly classified into two types:
  - **Discrete Data** : This is a whole number (or count) of attributes like:
    - Number of people buying a product
    - Number of defects per 1000 events
    - Number of satisfied customers
  - **Continuous Data**: This is information that can be measured on a continuum or scale e.g.
    - Weight of packages sent
    - Customer wait time for every customer service call
    - Average speed of cars traveling on a highway
- Why is understanding of data types important? One of the first steps that one has to perform with any data is to determine whether the data is discrete or continuous. Depending on whether the data is discrete or continuous, different Six Sigma tools should be used to get information from and perform analysis of the data.

Important Data Collection Techniques: Surveys

- Since data available may be very extensive, it is important to use appropriate mathematical and statistical techniques to measure data and reach appropriate conclusions. Surveys are used to get information from a small groups of customers and then extrapolate the results to the whole user base.

- In Six Sigma, conducting a proper survey is extremely important because inputs from the survey reflect the opinions of the customers and are used as the basis for critical decisions. Over time, surveys have become very scientific.

- Surveys are divided into three high level steps

Conducting Surveys (continued)

Creating and validating the questionnaire

- **Determining types of questions. Some examples are:**
  - Demographic : Demographic information about the customer (e.g. gender, age, nationality etc.)
  - Attitudinal : Attitude and views of the customer (e.g. likes/dislikes, expectations etc)
  - Service/Product Attributes : How the customer perceives different parameters of the product or service
- **Determining Response types**
  - Open Ended questions : questions which request the customers to write down their views or opinions (e.g. What is your perfect holiday? _____)
  - Rating questions: Request customers to select from possible values which are rated along a scale (e.g. How would you rate the customer service provided by XYZ company?
    - - Very Good
    - - Good
    - - Satisfactory
    - - Not Satisfactory
    - - Poor
    - - Very Poor)

Conducting Surveys (continued)

Ranking questions

- Request customers to provide a rank or numerical value to a particular attribute (e.g. What is the rank between 1 through 5 you would give to the features available in XYZ product : 1 represents Very Satisfied with features and 5 represents Not At All satisfied)

- Yes/No questions: Request customers to provide either Yes or No answer to a question. (e.g. Do you earn more than $ 50,000 in a year?)

- Likert or Intensity Scale : Measure strength of an attitude or opinion.

Validating the questionnaire

- Once the questionnaire is created, the questions are validated to ensure that all the questions are relevant and are framed correctly

- A pilot study may be done by a small group of users to see if they understand the questionnaire.

Conducting Surveys (continued)

Sending the questionnaire to respondents : Once the questionnaire is completed and validated, it is then sent to a selected sample of people. The questionnaire could be sent through various means including physical mailing, emails, web-forms, physical delivery by people etc.

Collecting and Analyzing the data: Once the questionnaire is filled up, the information from the questionnaire is collected and analyzed using appropriate tools

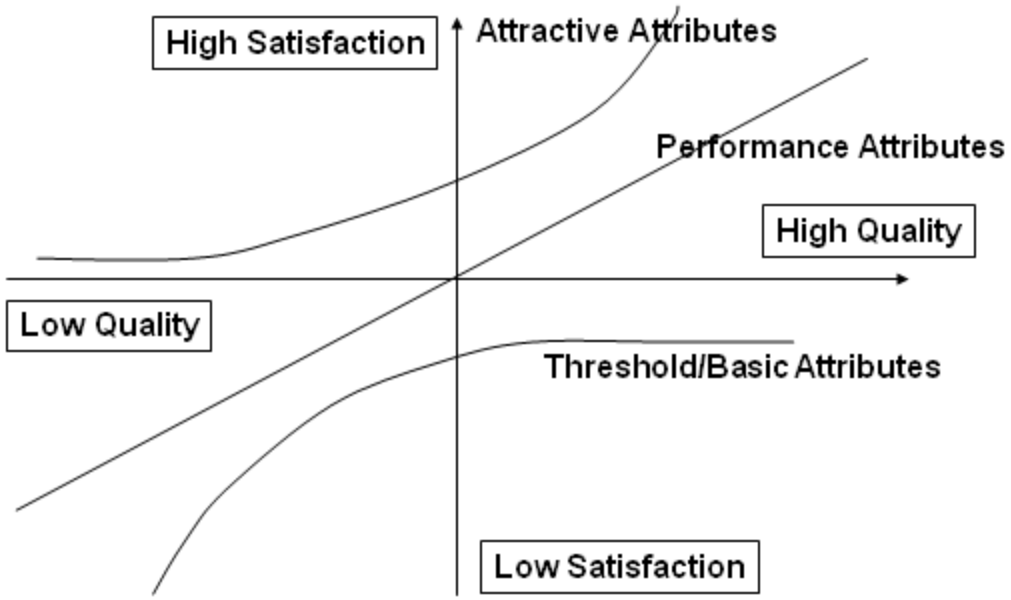
Important Data Collection Techniques: Focus Groups

- Focus group is a powerful method to evaluate the 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).
- The facilitator plays a very important role in the focus group – he/she creates an environment which allows free flow of information so 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 obtained on issues which are important from the company's perspective.
- Since focus groups are open-ended discussions, they cover a much wider range of issues than can be addressed through surveys. They are relatively inexpensive and can be easily organized. However, since the focus groups are usually small (i.e. 6 – 10 people), the inputs are limited to information obtained from the small group. Also, the effectiveness of a focus group depends a lot on the ability of the facilitator.
- Some other important data collection techniques include Interviews (one-to-one interviews of people) and Observation (e.g. observing the behavior of customers)

Kano Model (Determining Product Attributes Perceived to be Important by Customers)

- Developed by Professor Noriaki Kano, the Kano Model is very effective in differentiating between the various attributes of a product from a customer's 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 dissatisfier. 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 which delight a customer so he is quite willing to pay a premium. At most times, customers would be unaware of these attractive attributes, since they may be driven by innovation, and cutting edge technology which customers may not be familiar with.
- Customer satisfaction and competitive advantage can be acquired through improving the performance attributes and attractive attributes. It is important to note that customer expectations change over time – so, an attribute which was considered attractive earlier (e.g. air-bags in cars) may become a threshold/basic attribute over time.

Kano Model (continued)



- Please note: Through identification of defects and price of non-conformance, Six Sigma addresses the attributes which are below the performance attribute line. But the influence of Six Sigma includes the ability to identify attractive attributes and hence being creative – this helps in creating products that “delight customers” and ensure long term viability and competitive advantage.

Quality Function Deployment (QFD) or House of Quality

- After getting inputs from the customer, QFD can be used to map the voice of the customer to internal company processes and also provide competitive evaluation. QFD analysis includes inputs from all groups inside the organization, and forms the basis for determining the requirements of the project.

- 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.

QFD (continued)

- Quality Function Deployment is a very powerful tool in Six Sigma because it provides the following information:

1. What customers want : This forms the basis for the QFD and shows what the requirements of the customer are (typically referred to as “whats”).

2. How to accomplish: This is provided by the organization’s technical team, which highlights how satisfying the customer ‘s wants can be accomplished (typically referred to as “hows”).

3. Relationship: This shows the relationship between the hows (how to accomplish) with the ‘whats (customer wants) (i.e. strong relationship, medium relationship, weak relationship or no relationship).

4. Co-relationship Matrix: This shows the relationship between various ‘hows’ of the processes (how to accomplish).. The relation may be positive, neutral or negative. E.g., in an effort to design a faster car, the weight of a car and the mileage provided are negatively related.

QFD (continued)

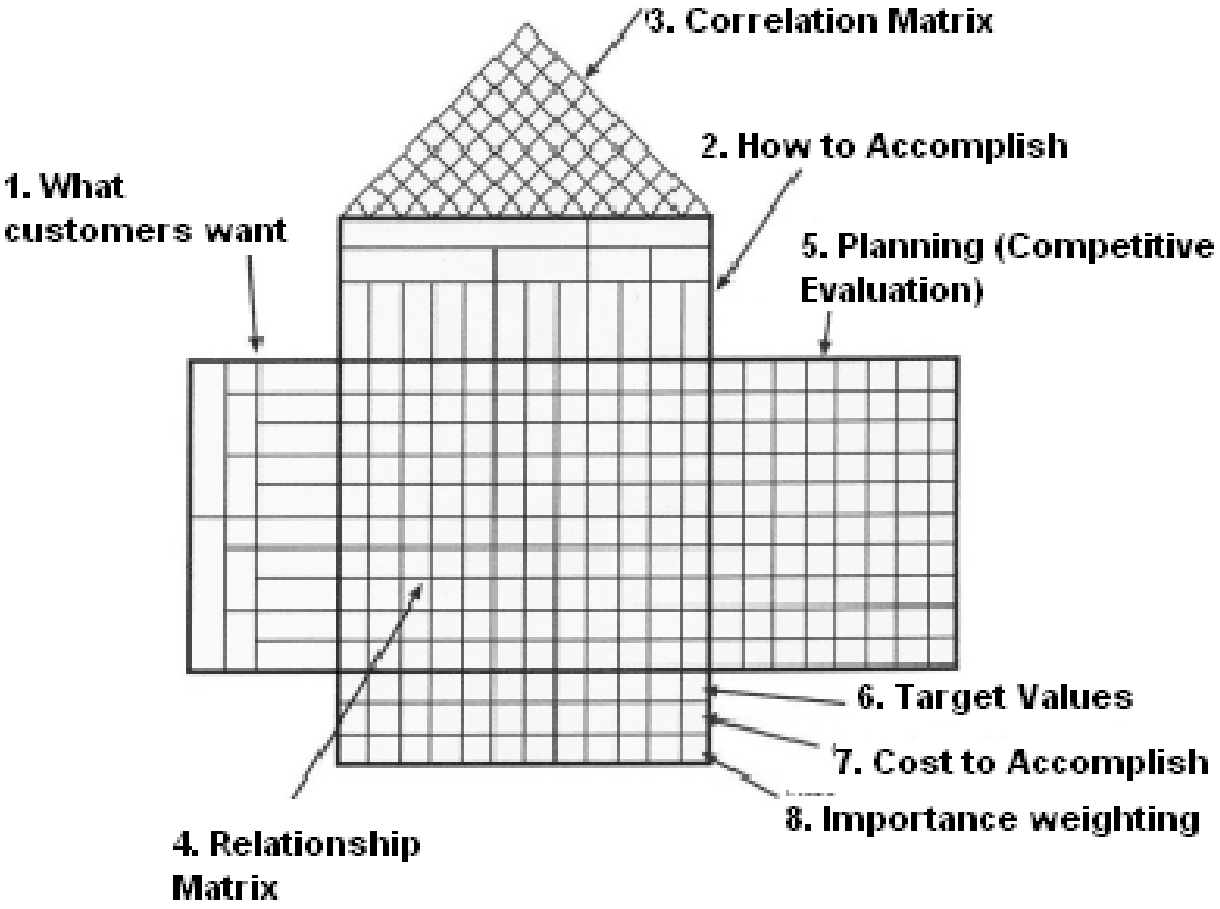
5. Planning (Competitive Evaluation): This shows the company's products and those of the competitors. By comparing the products, the team would know how the company rates on each of the customer's wants and helps the company in better understanding competition.

6. Target Values: This refers to the attributes of the product (or design target) desired by the company.

7. Cost to Accomplish: With the help of finance, the project team determines the cost which will be incurred to accomplish the target values in "6" above.

8. Importance Weighting: This shows the importance of a particular feature (e.g. cost/benefit calculation).

QFD (Continued)



Benchmarking

- Benchmarking is the process of measuring the company's performance against those of other best-in-class companies to determine the best practices to achieve those high performance goals. It forms the basis for determining the company's strategies, requirements and implementation plan.
- Robert Camp has broken the process of benchmarking into 10 steps which progress through 4 phases: (extract from Public Sector Management)

- **Phase 1 : Planning**
  - **Step 1** Identify what functions, products or outputs are essential practices and should be benchmarked.
  - **Step 2** Identify external organizations, or functions within one's own organization with superior work practices, for comparison.

- **Phase 2 : Analysis**
  - **Step 3** Determine what data sources are to be used.
  - **Step 4** Determine the current level of performance. This will enable the gap in performance to be identified. Camp emphasizes the importance of a "full understanding of internal business processes before attempting comparison with external organizations."

Benchmarking (continued)

- **Phase 3 : Integration**
  - **Step 5** Develop a vision for future operation based on the benchmarking findings. Focus should be on the quality of *best practice* procedures/practices and how these can be, not just emulated, but improved upon by the organization.
  - **Step 6** Report progress to all employees on an ongoing basis. Communication and feedback are crucial components of benchmarking.
- **Phase 4: Action**
  - **Step 7** Establish functional goals linked to the overall vision of the organization.
  - **Step 8 & 9** Develop action plans and implement the best practice findings. This should be the responsibility of the people who actually perform the work. Periodic measurement and assessment of achievements should be put into place.
  - **Step 10** Update knowledge on current work practices. This is, in essence, the crux of continuous quality improvement.

Important Process Performance Metrics required for Six Sigma

- **Defects vs. Opportunities**: As defined by Crosby, “Defect is a failure to conform to requirements.” Opportunity is any area within a process where a defect could be produced or where one fails to achieve the ideal product in the eyes of the customer. Opportunities are the things which must go right to satisfy a customer.
- **DPU (Defects per unit):** Number of defects / Number of products e.g. If 1000 units and 25 defects, the DPU = 25/1000 = .025
- **RTY (Rolled Throughput Yield):** Probability that a single unit can pass through all the processes without any defects. e.g. there are 3 processes required for manufacturing a unit. Process A has a success rate of 90%, Process B has a success rate of 80% and Process C has a success rate of 90%. What is the Rolled Throughput Yield for the unit?
    - Ans: RTY (Rolled Throughput Yield)

      = Probability that a single unit can pass through all processes without defects

      = Success probability of process A * Success Probability of process B * Success of process C

      = 0.90 * 0.80 * 0.90

      = 0.648
- **DPMO (Defects per Million Opportunities)**:. It is defined as

  dpmo=(number of defects * 1,000,000) / (total number of opportunities)

Financial Measures Net Present Value (NPV) And Present Value (PV)

- Net present value (NPV) = (present value* of all cash inflows) - (present value* of all cash outflows).
- Project selection criteria: select the project with the maximum net present value. The time value of money is already taken into account while calculating NPV.
- Example: there are 2 projects. Project A has as an NPV of $ 1,000 and will be completed in 5 years. Project B has an NPV of $ 800 and will be completed in 1 year. Which project will you select?
- Answer : Project A will be selected. <The fact that project B has a smaller duration than project A does not matter because time is already taken into account in NPV calculations>.

- Present value*(PV) = PV is the future value (FV) of a payment discounted at a discount rate (r) for the delay in payment**.**

Financial Measures Net Present Value (NPV) And Present Value (PV) (continued)

Example of PV: assume that $ 1,100(FV – future value) is going to be invested one year (n) from now. The discount rate (e.g. Inflation) is 10% (r) . what is the present value? (PV).

Answer:

$$PV = \frac{fv}{(1 + r/100)n} = \frac{\$\ 1{,}100}{(1 + 10/100)1} = \frac{\$\ 1{,}100}{1.1} = \$\ 1{,}000.$$

What this means: if you are expecting to get $ 1,100 1 year from now, its present value is only $ 1,000 – this is because the value of money decreases every year**.**

Discount Rate: The interest rate used to calculate present value of expected yearly benefits and costs.

Internal Rate of Return (IRR)

- Internal rate of return (IRR).
  - Discount rate on an investment which makes present value of cash inflows = present value of cash outflows.
  - Project selection criteria : select a project with higher IRR.
- Example: there are 2 projects. Project A has an IRR of 15% and will be completed in 5 years. Project B has an IRR of 10% and will be completed in 1 year. Which project will you select?
- Answer : Project A will be selected. (The fact that project B has a smaller duration than project A does not matter because time is already taken into account in IRR calculations).

Payback Period , Life Cycle Cost

- Payback period: Number of years required for an organization to recapture an initial investment.
- Discount rate is not taken into account in calculations for payback period.
- Project selection criteria: select a project with lower payback period.
- Example: There are 2 projects. Project A has an investment of $ 500,000 and payback period of 3 years. Project B has an investment of $ 300,000 and payback period of 5 years. Using the payback period criteria, which project will you select?
- Answer : Project A will be selected. <The fact that project B has a smaller investment than project A will not impact the selection >.

- Life Cycle Cost: The overall estimated cost for a particular program alternative over the time period corresponding to the life of the program. Includes
  - Direct and Indirect Costs
  - Periodic or continuing costs of operation and maintenance

- Project Selection Criteria: For 2 projects having same investment, select a project with lower Life Cycle Cost.

Benefit Cost Ratio (BCR)

BCR = benefits (or payback or revenue).
Costs

Selection criteria: select project with higher BCR.

BCR of > 1 means that benefits (i.e. Expected revenue) is greater than the cost. Hence it is beneficial to do the project.

Project selection criteria : select a project with the greater BCR.

Example: There are 2 projects. Project A has an investment of $ 500,000 and BCR of 2.5 project B has an investment of $ 300,000 and BCR of 1.5 using the benefit cost ratio criteria, which project will you select?

Answer : Project A will be selected. <The fact that project B has a smaller investment than project A will not impact the selection >.

- Benefit / Payback / Revenue = Cost + Profit incurred OR Cost – Loss incurred

Opportunity Cost, Sunk Cost

Opportunity cost:

This is the cost of passing up the next best choice when making a decision

Once the best option is decided, the opportunity cost of not doing the other next option is determined – this is used to calculate opportunity cost

Example: There are 2 projects. Project A has as an NPV of $ 1,000. Project B has an NPV of $ 800. What is the opportunity cost if Project A is selected?

Answer : If project A is selected, NPV is $ 1,000. However, if project A is selected, project B will be rejected i.e. a project with a potential NPV of $ 800 will not be done. Hence the opportunity cost of Project A = $ 1,000 - $ 800 = $ 200

- Sunk Cost:
  - This is the cost that has already been incurred – therefore cannot be avoided.
  - Project Selection Criteria: When deciding the best option, ignore the sunk costs, because they have already been incurred and cannot be avoided.

Opportunity Cost, Sunk Cost (continued)

- Example: Project A had initial budget of $ 1,000 out of which $ 800 has already been spent. To complete project A, we will need additional $ 500. Project B will require $ 1200 for completion. Which project do you want to select?

- Answer : $ 800 spent in project A is sunk cost – hence should be ignored. So, at this point of time,

    - Cost of completing project A = $ 500
    - Cost of completing project B = $ 1200

- Hence, we should select project A