

Section II

DFSS: Pre-Define and Define (DMAIC)

Agenda

- ✓ DFSS – Design for Six Sigma and DMAIC versus DFSS
- ✓ Pre-define Activities
- ✓ Define

Section II, Lesson 1

DFSS – Design for Six Sigma and DMAIC versus DFSS

Agenda

- ✓ Design for Six Sigma (DFSS)
- ✓ DFSS Approach to Problem Solving
- ✓ DMAIC Approach to Problem Solving
- ✓ DMAIC versus DFSS
- ✓ DFSS Tools
- ✓ Toll Gate Review
- ✓ Benchmarking
- ✓ MSA
- ✓ VOC

- ✓ Needs Vs. Requirements
- ✓ KJ Diagram
- ✓ Quality Function Deployment (QFD)
- ✓ Kano Model
- ✓ HOQ
- ✓ AHP
- ✓ Pugh Matrix for Concept Selection
- ✓ Sample Pugh Matrix
- ✓ Monte Carlo Simulation
- ✓ Design for X

What is Design for Six Sigma(DFSS)?

- ✓ Design for Six Sigma (DFSS) approach determines the needs of the customers and business; and drive those needs into the product, process, or service solution.
- ✓ Traditional Six Sigma DMAIC seeks continuous improvement of a process that already exists. DFSS helps in getting things right, the first time.
- ✓ Design for Six Sigma (DFSS) aims to create a process with the “end” in mind. It strives to optimally build the efficiencies of Six Sigma methodology with a measurably high process-sigma into the process before implementation.
- ✓ Implementation of DFSS provides confidence that the business has made active effort to understand the customer needs while planning and creating the product or service rather than reacting to customer complaint and issues.
- ✓ Design for Six Sigma offers two approaches under its umbrella – DMADV (Define, Measure, Analyze, Design, Validate) and IDOV (Identify, Design, Optimize, Validate).

- ✓ **Define** – Define the customer requirements
- ✓ **Measure** – Understand how to measure the customer requirements
- ✓ **Analyze** – Meet the customer requirements, and forecast possible variability
- ✓ **Design** – Integrate key findings of Analyze to building of product or service
- ✓ **Validate** – Test run of the product or service to understand the real-time performance of the process or product

The complexity of these stages means a DFSS project on an average runs much longer than a DMAIC project.

- ✓ **Define** – Define the problem
- ✓ **Measure** – Measure the problem
- ✓ **Analyze** – Analyze the root cause and variations
- ✓ **Improve** – Improve the process
- ✓ **Control** – Control the process and sustain the improvements

Differences

- ✓ Conceptually, DMAIC is an approach to improve existing processes, while DFSS is an approach to create new products or processes.
- ✓ DMAIC focuses on one or two CTQs (critical to quality) provided by the customer and aims to improve the performance of those CTQs while DFSS focuses on delivering a product or a service that meets **all the CTQ metrics**.
- ✓ Benchmarking is not an integral concept to most DMAIC efforts although it does play a crucial role in DFSS projects.

Similarities

- ✓ Some tools are used interchangeably between DFSS and DMAIC approach.
- ✓ Both DFSS and DMAIC strive for Six Sigma levels of performance.
- ✓ Both are built on Six Sigma philosophy.

Popular DFSS tools are mentioned here:

- ✓ Toll gate review
- ✓ Benchmarking
- ✓ MSA
- ✓ VOC
- ✓ Needs vs. requirements
- ✓ KJ diagram
- ✓ QFD
- ✓ Kano model
- ✓ HOQ
- ✓ AHP
- ✓ Pugh matrix for concept selection
- ✓ Monte Carlo simulation
- ✓ Design for X

- ✓ The project status is reviewed at the end of every phase by the senior management, Six Sigma team, and technical staff.
- ✓ To understand if the project has made adequate progress, and the product or the service is on target to meet what the customer wants.
- ✓ Each stage must have a list of deliverables set out. During the course of the stage, the deliverables are attempted to be met; and in the ensuing stage review, the deliverables are reviewed.
- ✓ Toll gate reviews also allow the team to eliminate obstacles in the way of the project completion.

- ✓ Benchmarking is the process of identifying industry's best performance or best practices from another industry, and comparing them with their own business processes and performance metrics.
- ✓ Three types of benchmarking practices exist – Internal, competitive, and functional.
 - **Internal** – Identifying the best practices in the business.
 - **Competitive** – Researching products or services across competitors.
 - **Functional** – Identifying and studying organizations that are considered ideal in the function.
- ✓ **Limitations**
 - What worked at one company may or may not work in another company.
 - A possible scope of killing creativity.

- ✓ MSA stands for measurement system analysis.
- ✓ Measurement system analysis helps in achieving higher accuracy of measurements and minimizes the risk of flawed data. Flawed data could lead to flawed analysis and further flawed inference.
- ✓ MSA involves six factors – 1) Repeatability, 2) Reproducibility, 3) Stability, 4) Linearity, 5) Bias, and 6) Discrimination.
- ✓ As per automotive industry action group (AIAG), the guideline based on measurement error % is:
 - Under 10%, measurement system is acceptable.
 - 10% - 30%, measurement system is acceptable with conditions.
 - > 30%, measurement system needs correction.

Detailed process to conduct MSA for different data types is explained in Section 3, with relevance to DMAIC approach along with the necessary tools.

- ✓ VOC stands for voice of customer.
- ✓ It is used to capture stated or unstated customer needs or requirements.
- ✓ Within any organization, there will be multiple customer voices: the procuring unit, the user, and the supporting maintenance unit. Within those units, there may also be multiple customer voices. The project team must consider these diverse voices while developing designs.
- ✓ Focus groups and customer surveys are popular techniques used for collecting voice of customer and in understanding their needs.
- ✓ One of the first things a Black Belt must do on receipt of VOC comments, whether in DFSS or DMAIC project, is to know that these comments may be raw and need to be categorized and analyzed systematically.
- ✓ VOC is sometimes also referred to as VOTC (Voice Of The Customer).

Needs Vs. Requirements

✓ Requirements:

- Stated by the customer.
- May not reflect the true needs.
- Subject to interpretation related mistakes.
- These are explicitly stated.

✓ Needs:

- Needs are something that the consumer actually wants.
- These are implicit requirements and needs to be understood.

✓ It is very important to understand the difference between needs and requirements.

✓ While capturing VOC, it is important to ensure that not just the stated requirements but the implicit needs are captured accurately.

- ✓ The affinity diagram was developed by Kawakita Jiro to help in discovering meaningful groups of ideas within a raw list. It was named after him as KJ diagram or KJ analysis.
- ✓ KJ diagram sorts out disparate items from multiple sources into few essential statements.
- ✓ KJ diagram or affinity diagram should be used by the Black Belt immediately after he collects the customer requirements.
- ✓ For example, one may have got late because of sleeping late at night, waking up late, getting the bus late, chatting with friends, or some guests arriving at home. With the help of KJ diagram, these can be sorted out under the headings: Sleeping habits, guests, meeting friends, etc.

- ✓ QFD is a systematic approach for transitioning customer needs to design requirements.
- ✓ QFD shows the competitive strengths of a company's product versus its competitors' products in the same niche.
- ✓ QFD will also show the possible weaknesses in the product in terms of adhering to the customer's need (In DMAIC and DFSS projects).
- ✓ QFD was first developed by Professors Shigero Mizuno and Yoji Akao.
- ✓ The first step in QFD is the understanding of VOC and KANO model.

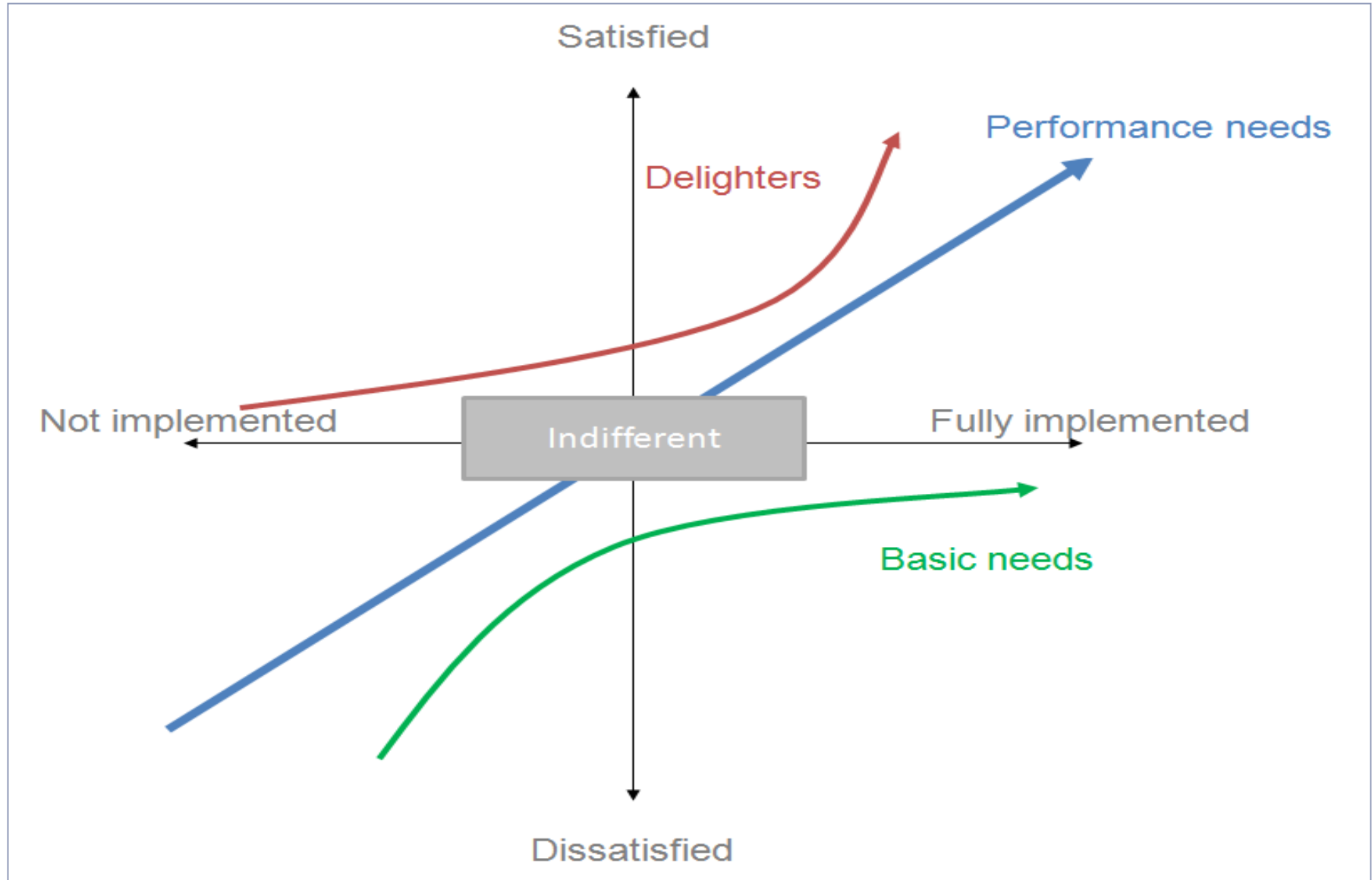
QFD can be extended to House of Quality (HOQ) to get a better understanding of process and customer needs. They are covered in detail in the DMAIC approach and are also a part of the toolkit.

- ✓ Assesses levels of customer satisfaction by ranking them on three parameters:
 - Basic needs (Unspoken requirements);
 - Performance needs (Spoken expectations); and
 - Delighters (Unspoken excitement attributes).
- ✓ Every product will have its own set of expectations from a customer. For example, if someone wishes to buy a car, he would expect windows, brakes, gears, and tires to be provided. These are basic needs' features.
- ✓ Mileage: Performance needs or expectations. If the manufacturer, doesn't give the quality, the customer gets dissatisfied. If he does, the customer gets satisfied.
- ✓ Car lock alarms: Exciting. This was not mentioned. If provided, the customer would be super-delighted. If not provided, he wouldn't be dissatisfied.

- ✓ The basic requirements of a product must be met in order for the product to be successful.
- ✓ The performance requirements should be prioritized in the order of what the customer wants, and should be delivered in order to stay in competition.
- ✓ The exciting requirements should be factored into the product, as part of a breakthrough strategy and differentiate with other competitors.

Important: Requirements should be sought and customer needs should be determined proactively and not reactively.

Kano Model (Contd.)



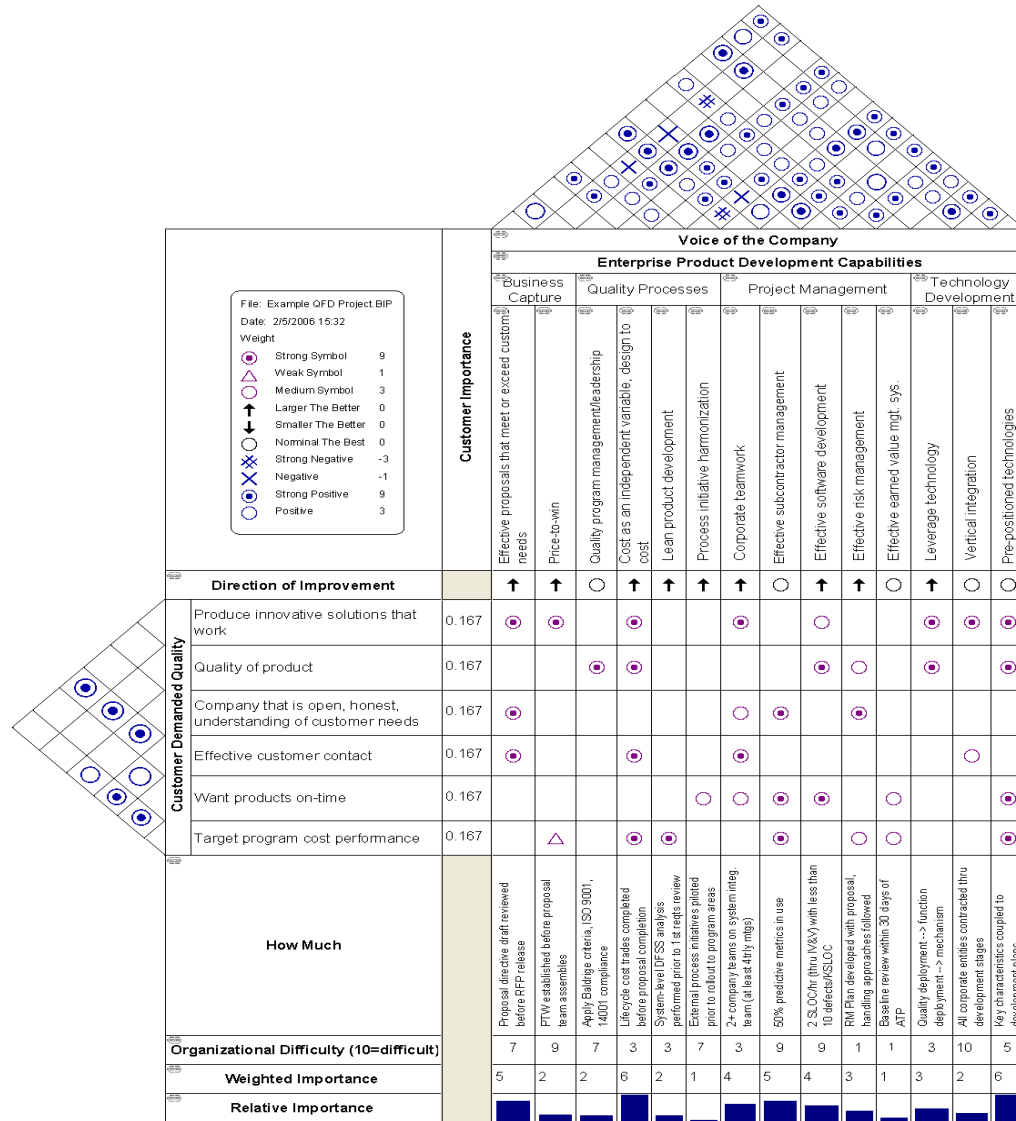
- ✓ Stands for house of quality, and in simple words, it is an extension of the quality function deployment.
- ✓ The HOQ helps the team organize their thinking in a structure way and reach a common consensus on what **the prime customer needs are**.
- ✓ The HOQ ensures all CTQs of customers are mapped, identified, and translated to the organization.
- ✓ The HOQ also acts as a tool for planning and organizing CTQs at all steps of design and development.
- ✓ The HOQ is an L-shaped matrix that allows the team to quantitatively analyze the relationship between customer needs and service features.

✓ There are 4 key phases in updating HOQ:

- Phase 1 – Product planning – Translate the customer needs to prioritized top company metrics or measures.
- Phase 2 – Part planning – Translate design requirements to part characteristics.
- Phase 3 – Process planning – Move part characteristics into process design.
- Phase 4 – Production planning – Move process characteristics to production and process requirements.

HOQ template has been provided in the Black Belt toolkit.

HOQ (Contd.)



- ✓ AHP stands for analytic hierarchy process. It is a structured technique based on mathematics and psychology for organizing and making complex decisions.
- ✓ Information is decomposed into a hierarchy of alternatives and criteria.
- ✓ Information is then synthesized to determine relative ranking of alternatives.
- ✓ Both qualitative and quantitative information can be compared using informed judgments to derive weights and priorities.
- ✓ Process for using AHP:
 1. Model the problem as a hierarchy that has the goal and alternatives;
 2. Establish priorities;
 3. Synthesize judgments to establish overall priorities in hierarchy;
 4. Check consistency of judgments; and
 5. Arrive at a final decision based on the process.

This is a useful tool which helps in arriving at an informed decision when there are multiple concepts that need to be narrowed down.

AHP (Contd.)

Tom

Dick

Harry

Goal:

Choose a Leader
1.000

Criteria:

Experience
.547

Education
.127

Charisma
.270

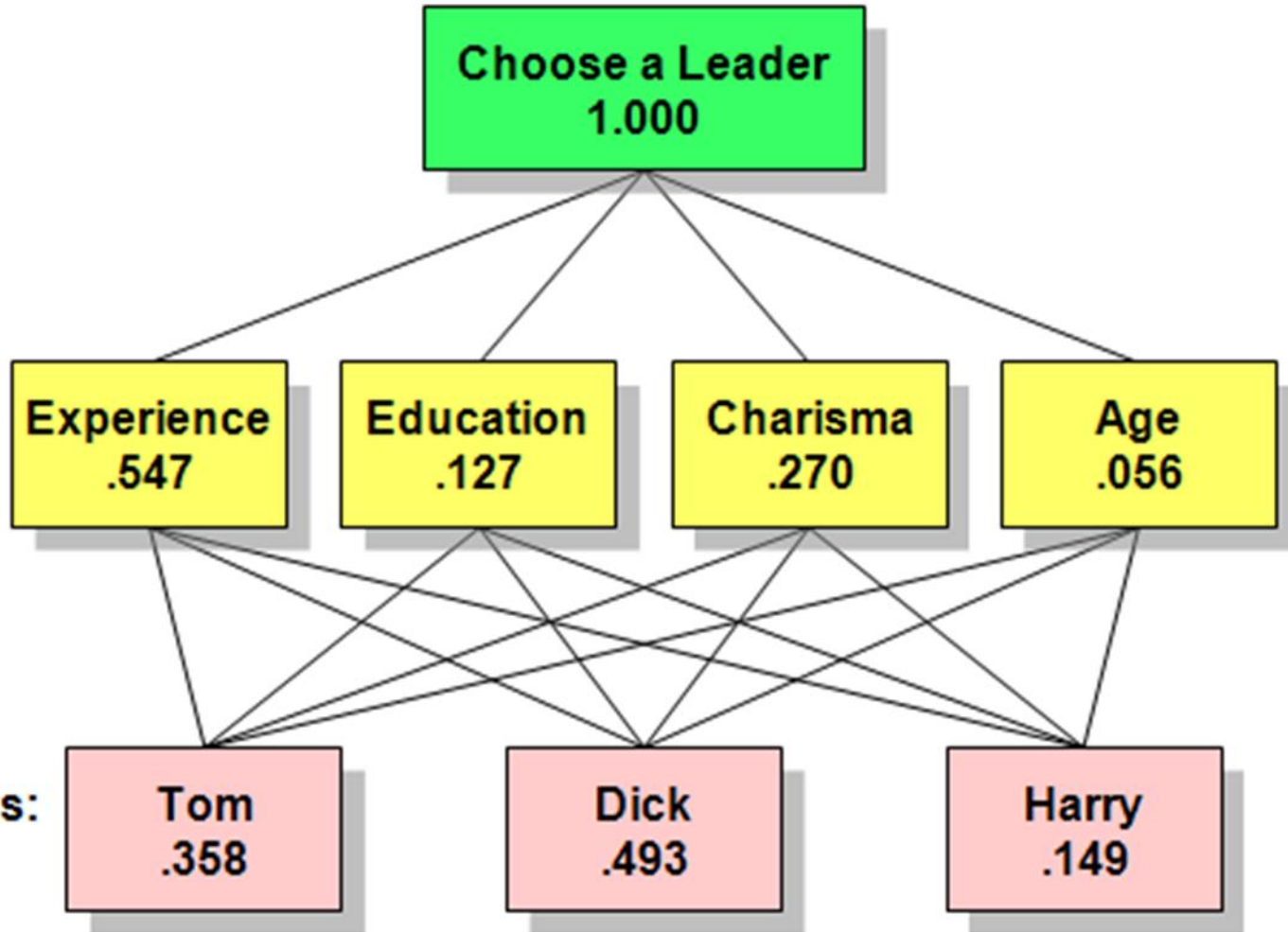
Age
.056

Alternatives:

Tom
.358

Dick
.493

Harry
.149



Pugh Matrix for Concept Selection

- ✓ Pugh matrix is a method for selecting a concept amongst multiple concepts by using a scoring matrix, and is used in almost **all DFSS implementations**.
- ✓ Pugh matrix is closely tied to the QFD and is in the form of a prioritization matrix.
- ✓ Options are scored relatively (better than, worse than, or neutral).
- ✓ This method is effective only when there are multiple solution alternatives and it is necessary to choose one for the project deployment.

Pugh matrix for concept selection tool has been provided as part of the toolkit. Refer to the tool and facilitator for guiding through the steps shown in the next slide to know how this tool is used.

✓ How to update the Pugh matrix?

1. Choose or develop the criteria for comparison.
2. Select the alternatives (new solutions) to be compared.
3. Generate scores for each solution. Better solutions to be scored +1, neutral solutions to be scored 0, and worse solutions to be scored -1.
4. Compute the final score based on the scoring done.

Important: Always ensure the presence of a process expert in updating the Pugh matrix for selecting concepts. The Black Belt's responsibility is to ensure the Process Expert's attendance.

Sample Pugh Matrix

		Baseline	Alternative Solution	
Criteria	Criteria Priority (Optional)	Current Solution	New System	Enhance Old System
Effectiveness	9	0	9	3
Availability of resources	6	0	3	9
Support from owner	3	0	9	3
Long term benefit	6	0	9	0
Time to implement	5	0	-9	-3
Ease to implement	3	0	-9	-9
Cost to implement	8	0	-9	0
Applicability elsewhere	2	0	9	0
			54	48

Monte Carlo Simulation

- ✓ Monte Carlo simulation is a computer simulation technique that allows people to factor in risk, in qualitative decision making.
- ✓ For any choice of action, it provides a list of possible outcomes along with the probabilities of their occurrence. These information helps in decision making.
- ✓ The simulation also shows extreme events, i.e., events that have maximum probability (sun during summer) and least probability (earthquake) to occur, and also the events that lie right in the middle of a typical probability distribution.
- ✓ Output values are sampled randomly from input probability distributions.

Important: Understanding how Monte Carlo simulations work is important for a Black Belt. Doing Monte Carlo simulations and its analysis will need guidance from Master Black Belt.

- ✓ Design for X, also known as DfX, is a summary of a wide collection of specific design guidelines.
- ✓ Each design addresses a particular characteristic of a product by which the customer may be affected.
- ✓ DfX addresses issues in the following phases of a typical product cycle:
 - Development – Design for test, design for safety;
 - Production – Design to cost, design to standards;
 - Utilization – Design for ergonomics, design for aesthetics; and
 - Disposal – Design for environment.

This lesson discussed:

- ✓ What DFSS is, and how DFSS is different and similar to DMAIC.
- ✓ Various steps in a typical DFSS cycle.
- ✓ Some tools used concurrently in DFSS and DMAIC.

Section II, Lesson 2

Pre-Define Activities

- ✓ Prerequisites of a Six Sigma Project
- ✓ Qualifications of a Six Sigma Project
- ✓ Cornerstones of a Six Sigma Project
- ✓ Six Sigma Deployment Cycle Plan
- ✓ 10 Point Ongoing Project Evaluation
- ✓ Project Prioritization Matrix
- ✓ Enterprise Wide versus LOB View
- ✓ Enterprise Wide – Roles and Responsibilities
- ✓ Net Present Value (NPV)
- ✓ Internal Rate of Return (IRR)
- ✓ NPV and IRR – An Example

Prerequisites of a Six Sigma Project

- ✓ The prerequisites help a Black Belt answer if this could be a possible Six Sigma project.
- ✓ Often, the Project Champion sets up the case of the project and is not aware of, technically, which approach needs to be used.
- ✓ Here are the questions that need to be answered:
 1. Are there issues in process / product / service quality?
 2. Does this appear to be a chronic problem?
 3. Is the problem measurable?
 4. Does it impact customer satisfaction?
 5. Does this impact financial profits?

If all 5 questions have been answered yes, the Black Belt can continue to the qualifications. If one of the question is answered no, this is not a Six Sigma project.

Qualifications of a Six Sigma Project

- ✓ After determining a project to be a possible Six Sigma project, the Black Belt needs to be sure that the project could be a certain Six Sigma project for which the qualifications are studied.
 - Is there a gap between ideal and actual? – Y/N
 - Is the root cause of the problem known? – Y/N
 - Is the solution apparent? – Y/N
- ✓ Question 1 needs to be answered Y, and 2 and 3 N. If so, then qualifications are met and the project is a certain Six Sigma project.

Cornerstones of a Six Sigma Project

- ✓ The Six Sigma team starts the project only after completing the pre-requisites and qualifications check successfully.
- ✓ To call a project a Six Sigma project, we need to answer the following questions:
 1. Did the team understand variations during the project?
 2. Did the team understand process capability?
 3. Did the team measure defects?
 4. Did the team implement DMAIC approach?
- ✓ If all the questions are answered as yes, go to the next step of checking if the following 4-step approach to problem solving can be applied.
 1. Document practical problem;
 2. Convert to statistical problem;
 3. Find statistical solution for the problem; and
 4. Convert the statistical solution to practical solution.
- ✓ After all these checks are satisfied, the project will be called a Six Sigma project.

Six Sigma Deployment Cycle Plan

Q1. Identify 6 sigma leader, draft and approve a Six Sigma plan, and identify core team members.

Q2. Tailor BB training, train Black Belts, train leadership, and prepare necessary documents.

Q3. Establish project validation criteria, identify master Black Belts, and commencement of establishing Six Sigma practices.

Q4. Certify Black Belts, issue Six Sigma practices, and train Green Belts.

Q5. Prepare detailed roadmap, train Green Belts, and train second wave Black Belts.

This quarter wise deployment cycle is the outline of all major activities intended to happen in a Six Sigma deployment cycle in a company.

10 Point Ongoing Project Evaluation

The 10 points that are needed to evaluate projects are follows:

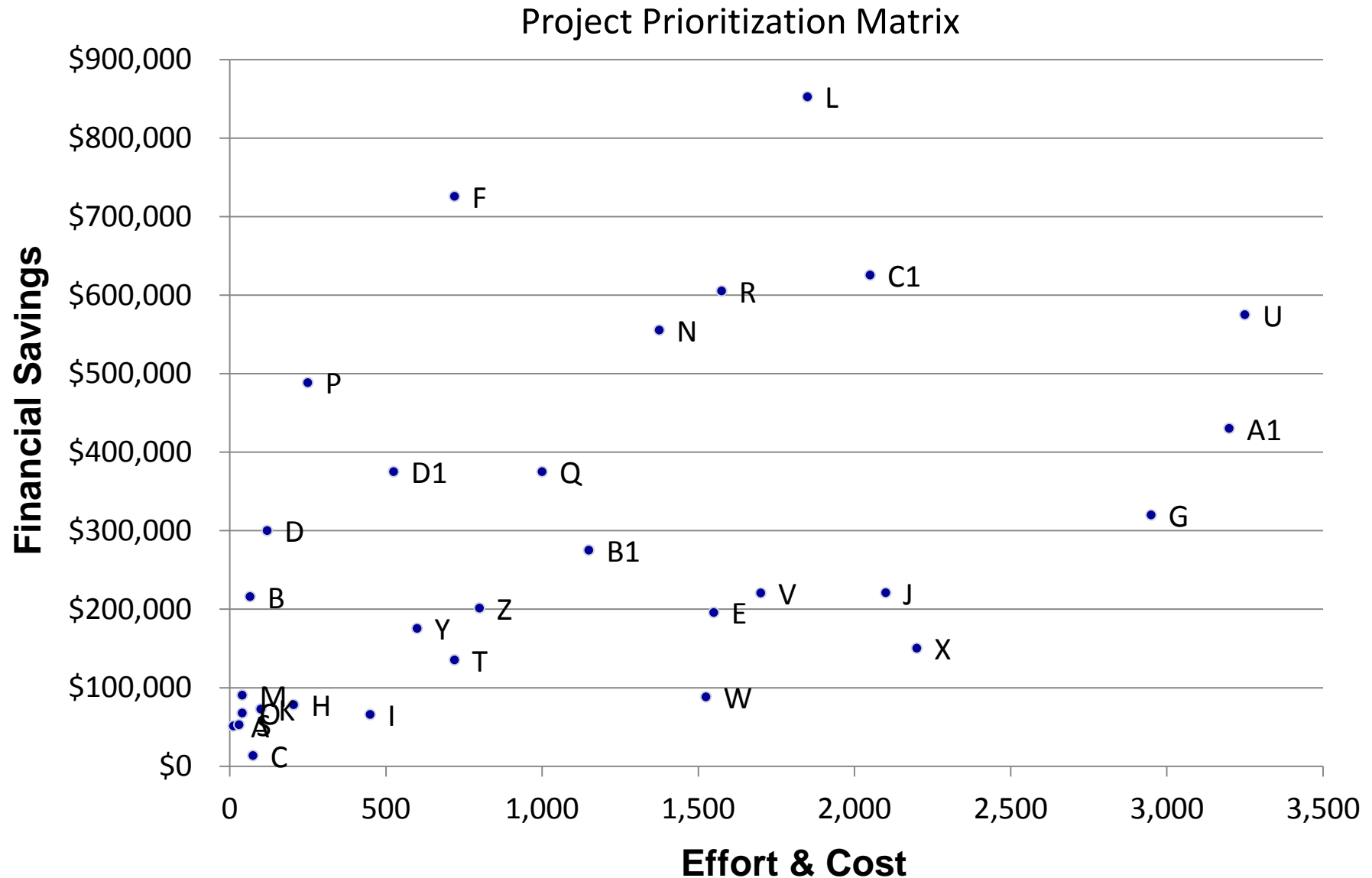
- ✓ Link to strategic initiatives
- ✓ Application of Six Sigma tools
- ✓ Active Sponsor engagement
- ✓ Active engagement of the team
- ✓ Organizational awareness of the project
- ✓ Project delivery on results
- ✓ On time completion
- ✓ Successful transition to Project Owner
- ✓ Improvement sustained over time
- ✓ Replication of results

Each of these metrics can be scored on low to high. Use the project evaluation check list provided in the toolkit.

Project Prioritization Matrix

- ✓ When there are multiple projects and it is necessary to prioritize them, project prioritization matrix can be used.
- ✓ This matrix shows the possible financial savings out of a project and anticipated time or effort to be spent on the project.
- ✓ This tool provided with the toolkit needs to be updated with the help of the finance team.
- ✓ The projects that have the maximum revenue impact on least effort spent will be the ones most likely to get approved, and should get approved.

Project Prioritization Matrix (Contd.)



- ✓ One of the key responsibilities of a Black Belt is to implement enterprise wide projects.
- ✓ Implementing a project across multiple departments needs a great amount of coordination amongst all departments, and least possible friction.
- ✓ These projects implemented across multiple departments should also be able to bring in cost savings or profit increase of more than \$200,000 annually.
- ✓ As part of strategy deployment plan, the roles and responsibilities of each designation of the team member must be sorted out, and clearly communicated to them in advance.

Enterprise Wide – Roles and Responsibilities

Responsible Entity	Role	Responsibility
Six Sigma council	Leadership	1. Suggests high impact projects 2. Approves project selection strategy
Six Sigma core team	Part time change agents	Facilitates Six Sigma activities like training, events, Black Belt meetings, etc.
Master Black Belt	Enterprise SS expert	Basic Black Belt training and mentoring
Black Belt	Six Sigma technical expert	Leads business improvement projects where Six Sigma approach is needed.

NPV (Net Present Value)

- ✓ Net present value is the difference between present value (PV) of cash inflows and the present value of cash outflows.
- ✓ Net present value can be positive, negative, or zero, as a result.
- ✓ NPV to be used because cost and benefits fluctuate over a period of time and do not normally come to an organization as a lump sum amount.
- ✓ In Microsoft Excel, one can calculate NPV with the help of function = NPV().
- ✓ This tool is used to show the return on investment to the management, and is often used as a very important pre-define tool. In the pre-define stage, the Black Belt needs to show the possible ROI on a project before getting the sign off for the project.

Internal Rate of Return (IRR)

- ✓ The **internal rate of return (IRR)** is a rate of return used in capital budgeting to measure and compare the profitability of investments.
- ✓ The IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.
- ✓ This is commonly used to evaluate the desirability of investments or projects. The higher a project's IRR, the more desirable it is to undertake the project.

NPV and IRR – An Example

- ✓ There is a project that will cost \$7,000 this year and \$1,500 next year, to implement. Next year, a benefit of \$500 is seen and the year after that 5,000. In the third year \$10,000 benefit is expected, and in the last two years \$15,000 benefit each. The management wants to see a rate of return of 10% over a five year period. We will find out if we can meet that with these figures. Below is the table that can be created in excel to show these figures and calculate the NPV.

Year	Cost	Benefits	Net Benefits	Description
			10%	Annual discount rate which management wants
0	-USD 7,000	USD 0	-USD 7,000	Initial Cost of investment
1	-USD 1,500	USD 500	-USD 1,000	Returns
2	USD 0	USD 5,000	USD 5,000	Returns
3	USD 0	USD 10,000	USD 10,000	Returns
4	USD 0	USD 15,000	USD 15,000	
5	USD 0	USD 15,000	USD 15,000	
Totals	-USD 8,500	USD 45,500	USD 37,000	
NPV			USD 21,177.55	=NPV(10%,-7000,-1000,5000,10000,15000,15000)
IRR			63%	=IRR(-7000,-1000,5000,10000,15000,15000, 10%)

NPV and IRR – An Example (Contd.)

- ✓ From the excel sheet, we find that NPV is approximately USD 21,000 as ROI for the management.
- ✓ The management will look at this number closely and grant an approval for the project based on other conditions like current cash flows and so on.
- ✓ The NPV calculation sheet is provided as part of the toolkit titled net present value.
- ✓ Another cost benefit metric is internal rate of return (IRR). In the NPV calculation tool, we will find IRR calculated to 63%. This is compared to the annual discount rate which management is expecting (in this example, management is expecting 10%).
- ✓ If IRR is greater than the discount rate, the likelihood of the management to give a go-ahead to the project is high.
- ✓ These cost benefit calculations can also be done during the define stage.

This lesson covered:

- ✓ Pre-requisites of a Six Sigma project
- ✓ Qualifications of a Six Sigma project
- ✓ Cornerstones of a Six Sigma project
- ✓ 4-step approach of problem solving
- ✓ Business feasibility of a Six Sigma project
- ✓ Enterprise wide versus LOB view
- ✓ Deployment cycle
- ✓ Cost benefit analysis

Section II, Lesson 3

Define

Agenda

- ✓ Key Objectives
- ✓ Voice of Customer
- ✓ Voice of Business
- ✓ Voice of Process
- ✓ VOC, VOB, and VOP
- ✓ Kano Model
- ✓ Assignment
- ✓ Translation to Project Y
- ✓ Quality Function Deployment
- ✓ Process Map

- ✓ Y – Baseline Performance
- ✓ SIPOC
- ✓ Project Charter
- ✓ The Problem Statement and the Goal Statement
- ✓ RACI Matrix
- ✓ Business Metrics
- ✓ Project Deliverables
- ✓ Project Scheduling
- ✓ Team Selection
- ✓ Roles and Responsibilities
- ✓ Tools Summary

Define – Key Objectives

- ✓ Map the project Y from customer needs
- ✓ Develop the project charter
- ✓ Define the scope, objectives, and schedule for the project
- ✓ Define the top level process and its stakeholders
- ✓ Select team members
- ✓ Obtain sponsor authorization
- ✓ Assemble and train the team

- ✓ Voice of customer (VOC) focuses on capturing customer needs and experience with current products and services.
- ✓ Understanding the customer's opinion on the current product or a process is extremely vital for the Six Sigma team. This often helps the Black Belt in identifying the opportunity for improvement.
- ✓ The tools used to gauge what the customer feels are focus groups, surveys, and interviews.
- ✓ For example, the customer of a phone service a company provides has been complaining of 3 major issues prioritized with the help of a Pareto chart.
 - He is always kept on hold;
 - He gets invoices irregularly; and
 - The delivery of the products is not timely at all.

- ✓ Voice of business is derived from financial information and data.
- ✓ Voice of business also captures company's core values and vision.
- ✓ Understanding and dissecting the financials and market scope helps the business to identify projects that will allow them to move towards the organizational goals.
- ✓ Voice of business is one of the first tools to be used in a Six Sigma project often before employing the voice of customer tools.
- ✓ Using voice of business helps in identifying revenue growth areas, and linking them to the voice of customer helps in identifying the exact project opportunity.

- ✓ The voice of business and voice of customer feed into the voice of process.
- ✓ The relevancy of the process to the business and customer needs are studied in detail in the voice of process section.
- ✓ Processes are categorized to high value and low value processes from the perspective of the product provided to the customer.
- ✓ Objectives of using VOP (voice of process):
 - Correlates the customer's voice to the voice of the process and see how well the process is shaping up currently to deliver the customer's needs.
 - Analysts can also identify poorly performing processes and identify them for potential projects.

✓ Scenario: For an improvement project in an call center, here are examples of what voice of customer, business, and process would look like:

- VOC: I am always put on hold.
- VOB: We are not taking enough calls.
- VOP: Our average handle time per call is high.
- In essence, the link is as shown below:



- ✓ Once comments from the customers, business, and process are obtained, the Black Belt should also map the KANO model to the quality characteristics.
- ✓ KANO model, helps in categorizing the features to basic quality features, performance quality features, and exciting quality features.
 - For example: When a customer is looking to purchase a car, he/she would look for certain features and characteristics. Here are some examples about the features and their category:
 - Car should look good: Basic
 - Should resist dents: Performance
 - Is able to protect lights: Exciting
 - Is inexpensive: Basic

Assignment

1. Map the top 5 customer needs from the service/product of your company.
2. Assign them random frequencies indicating that they are customer complaints.
3. Correlate the customer complaints to a business loss or loss in customer satisfaction. Customer satisfaction should be quantified by the number of customers reduced.
4. Assign them basic, performance, and exciting quality features.
5. Prioritize the complaints either by cost benefit analysis metrics or Pareto analysis.

Translation to Project Y

- ✓ Once the VOC, VOB, and VOP details are finalized, it is the Black Belt's responsibility to identify the project Y.
- ✓ While identifying project Y, it is necessary to prioritize all the points that are captured through VOC, VOB, and VOP. This can be done with the help of the worksheet provided, prioritizing cust req, as part of the toolkit.
- ✓ Here is the table representing the complaints by each customer around their experience with the car.

	Cust1	Cust2	Cust3	Cust4	Cust5	Cust6	Cust7	Sum	Sum %
Looks good	0	1	0	1	0	0	0	2	12.50%
Holds License plate	1	0	1	1	0	0	1	3	18.75%
Resist Dents	0	1	1	0	0	1	0	3	18.75%
Protects lights	0	0	0					0	0.00%
Doesn't rust	0	1	0	1	0			2	12.50%
Lasts a long time	1	0	1	0	1			3	18.75%
Inexpensive	0	0	1					1	6.25%
Protects tender	0	1	0	1				2	12.50%
								16	

Quality Function Deployment

- ✓ Quality function deployment is a DFSS tool which is used in DMAIC approaches at times.
- ✓ A Black Belt should be well conversant with the use of QFD matrix.
- ✓ The QFD matrix is a structured matrix consisting of below sections:
 - Customer needs: The leftmost section;
 - Technical features: The top horizontal section;
 - Interrelationship matrix: The matrix between needs and features;
 - Benchmarking room: Extreme right in the QFD template where company is benchmarked with competitors on customer needs; and
 - Testing room: Every technical feature is assigned a target to be tested on.

The QFD tool is provided with the toolkit. The QFD is updated with a sample case.

✓ How to update the QFD?

1. Document all the customer needs from the translation worksheet under column B of the QFD template.
2. Weights are assigned to the customer needs depending on how the customer prioritizes their needs based on importance.
3. Assign their respective KANO metric.
4. List out all the service features.
5. Correlate between service features and customer needs.
6. Benchmark only if needed. Present each technical features with their target.
7. Highlight the top 3 scores from row 41. These are prioritized service features.

- ✓ A sample QFD has been updated for reference in the toolkit. The case here is a chocolate cookie, which our company's customer buys from the shop. The customer needs are:
 - Good texture;
 - Generous portions;
 - Low price; and
 - Good taste.
- ✓ The QFD has been updated with technical requirements and their weights. 9 stands for strong correlation, 3 stands for moderate, and 1 stands for weak correlation.

- ✓ Process mapping is a technique to map the process.
- ✓ It can be used for both current process and to-be process.
- ✓ Visual representation of the end-to-end process.
- ✓ Identify non-value-added activities and waste.
- ✓ Standard flow chart techniques can be used to create process map.
- ✓ Swimlane diagram can be used to represent the process through various departments.

- ✓ In the define stage, it is important to know the project Y, which correlates to customer requirements. The VOC – Y tool in the toolkit will help to freeze on the potential project Y.
- ✓ In our case, with the help of the example provided in the toolkit, we ended up with three possible project Ys:
 - Availability;
 - Invoicing cycle time; and
 - Delivery cycle time.
- ✓ Collating details captured using VOB, VOC, and VOP, it was found that availability was indeed the key issue for the customer, working on which the business could gain immensely.

Why availability?

- ✓ Availability of someone being able to talk to the customer directly impacts customer satisfaction. In the last 6 months, from customer surveys, it was found that 100 customers left the company's services, out of a total clientele of 1000. The average loss per customer was billed at \$1,000 (by finance department).
- ✓ Due to poor availability, our company was attending to 200 calls less in a day, which further resulted in a daily loss of \$1,000, as the customers used to pay the company \$5 per call. Over 6 months thus, the company lost \$120,000. (finance department)
- ✓ **Purely from a financial sense, choosing availability as project Y for our case is imperative.**

- ✓ SIPOC stands for “supplier, input, process, output, and customer.”
- ✓ SIPOC map is a broad-level map which also helps in scoping the project.
- ✓ This map is prepared by green belts. All green belts from different curriculums are trained to update a SIPOC map.
- ✓ The Black Belt’s responsibility is to look at the SIPOC map for correctness and also help the team identify the scope of the project.
 - For example, in our case the availability issue has been mapped to the process of handling only calls related to after sales queries. Any new sales calls will not qualify to be a part of treatment of our project. This is called project boundary or project scope.

Project Charter

- ✓ Project charter is the main starting document for any Six Sigma project.
- ✓ It is the statement of the objective of the project, project scope, and goals.
- ✓ Lists all the participants of the project, outlines the key roles and responsibilities for the project team.
- ✓ Presents an insight into the key schedule milestones and deliverables for the project.
- ✓ Project charter document is used as:
 - Authorization of a project by Project Champion;
 - Primary sales document for the leadership team;
 - Focus point for the project and the team; and
 - Main starting document for Six Sigma toll gate review meeting.
- ✓ Project charter should be used proactively by the project leader (Black Belt or Green Belt). It should be kept updated on regular basis (weekly) with updated status and progress.

- ✓ Drafting the problem statement should be one of the key activities in the define phase, most importantly because the problem statement is the foundation of any improvement project. If the problem is not clear, the improvement project may not yield the right value.
- ✓ **Example of a poor problem statement**
 - The company has been incurring some loss.
- ✓ **Example of a good problem statement**
 - The company has been incurring a loss of \$150,000 over the last 6 months due to non-availability of staff resulting in per call loss and client attrition due to dissatisfaction.
- ✓ **Goal statement**
 - Six Sigma project for improving availability of staff will help reduce customer turnaround time and handle more calls, resulting in revenue increase of \$100,000 within 6 months from the start of project.

RACI Matrix

- ✓ RACI stands for “responsible, accountable, consulted, and informed.”
- ✓ RACI matrix is a project management tool, which helps in identifying people and allocate roles and responsibilities for each of the task.
- ✓ This matrix is used as a formal document for assigning the roles and responsibilities for each individual associated with the project.
- ✓ RACI matrix tool is provided as part of the toolkit. A sample snapshot of the RACI matrix can be seen below.

	Role 1	Role 2	Role 3	Role 4
Task 1	R	A	C	I
Task 2	I	I	R	A
Task 3	C	A	R	I
Task 4	R/A	I	I	
Task 5	R	A	C	I
Task 6	C	C	R	A

- ✓ Business metrics for Six Sigma projects is one of the key points any Six Sigma project aims to work for.
- ✓ The performance of the business metrics could either be reduced or increased, resulting in an increase in the financial savings which is the key objective of implementing any Six Sigma project.
- ✓ Monitoring process capability indices is a good way of showing business results. If the process capability index value increases, the business performance increases.
- ✓ Another way of monitoring business performance is to check DPMO levels, or defects per million opportunities. If a product or service has certain opportunities of defects, all of those are considered and then actual defect rate is calculated and equated to DPMO.
- ✓ DPMO can be calculated for one or more CTQ characteristics.

- ✓ While using multiple characteristics to calculate DPMO, it should not be directly used as it is, as not all defects are same and some of the defects might not be severe from customer perspective.
- ✓ In such a scenario, the process analyst must seek to calculate defective items rather than defects.
- ✓ RTY or rolled throughput yield obtained by multiplying the first pass yields of all individual processes working in series mode is another business performance metrics used to represent probability of the process, to produce zero defects output.
- ✓ The Black Belt in consultation with Master Black Belt, Process Champion, and the Six Sigma team, choose the right set of business metrics that are relevant and representative for the Six Sigma project.

- ✓ For a Six Sigma project, the project goals should be either of cost, quality, or schedule.
 - CTQ – This is critical to quality characteristic of a product and aims towards the quality needs of a customer.
 - CTC – This is critical to cost characteristic of a product and aims towards the cost needs of a customer.
 - CTS – This is critical to schedule characteristic of a product and aims towards the schedule needs of a customer.
- ✓ Once the Six Sigma team gets its list of requirements from the customer, it has to map them to CTQ, CTC, and CTS. This helps them identify the right set of targets and work towards it.

- ✓ The Black Belt should be able to schedule a project, understanding the complexity of the project that has been scoped.
- ✓ Below mentioned are typical of a Six Sigma DMAIC Black Belt enterprise wide initiative:
 - Pre-define – 15 days;
 - Define – 45 days;
 - Measure – 60 days;
 - Analyze – 30 days;
 - Improve – 30 days;
 - Control – 90 days; and
 - Then a typical enterprise wide Black Belt initiative would last for 270-300 days, i.e., approximately 9 – 10 months.

A Black Belt can use Gantt charts to schedule his projects. A Gantt chart template has been provided with the toolkit which can be used by the Black Belt.

Team Selection

- ✓ On finalizing the project charter and Sponsor, the Black Belt should conduct a meeting with manager of functional groups informing them of the initiation of the project.
- ✓ Goal of this meeting is to allow managers of functional units to appoint one person from their team for participation in the project.
- ✓ Six Sigma project team should have one team member each from every stakeholder group. These team members may or may not be Six Sigma certified.
- ✓ Permissible team size is 5-7, with representation from each stakeholder group.
- ✓ All project team members to be apprised of the project objective and the business case.

✓ Charting project

1. Identify opportunity for improvement – Black Belt
2. Identify sponsor – Black Belt
3. Estimate savings – Black Belt
4. Draft project charter – Black Belt and sponsor
5. Review project – Sponsor and Black Belt

✓ Define

1. Team selection – Sponsor and Black Belt
2. Complete charter – Black Belt and Green Belt
3. Team training – Black Belt and Green Belt
4. Review existing process – Green Belt, Black Belt, and process owner
5. Define objectives and plan – Six Sigma team
6. Present objectives to management – Green Belt

The tools must be used in chronological order in a typical define phase of a DMAIC implementation.

1. VOC, VOB, and VOP
2. KANO model
3. QFD only if needed
4. Translation to Y worksheet
5. SIPOC
6. Project charter and problem statement
7. RACI matrix
8. Gantt charts

In this lesson we discussed:

- ✓ VOC, VOB, and VOP
- ✓ Kano model
- ✓ Translation to project Y
- ✓ Quality function deployment
- ✓ Y – Baseline performance
- ✓ SIPOC
- ✓ Project charter
- ✓ RACI matrix
- ✓ Business metrics
- ✓ Project scheduling
- ✓ Roles and responsibilities

1. The main aim of doing a DFSS project is to:
 - a) Improve the process capability
 - b) Improve the machine capability
 - c) Improve the defects per million count
 - d) None of the above

2. When would you consider benchmarking to be ineffective?
 - a) Lot of time is needed
 - b) Companies wouldn't disclose their strengths
 - c) Expert resources needed
 - d) Stifles creativity if not used properly

3. Typically, in which stage of a DFSS implementation would you employ QFD?
- a) Define
 - b) Measure
 - c) Analyze
 - d) Control
4. Which of the below mentioned Design Guidelines are applicable while designing for production?
- a) Design for Test
 - b) Design for Reliability
 - c) Design for Quality
 - d) Design for Cost

5. Which of the tools would you use to collect voice of customer comments?
- a) Brainstorming
 - b) KJ Diagram
 - c) NGT
 - d) Focus Groups
6. If the NPV of a project is - \$20,000, what should be the Black Belt's assessment?
- a) The project should be undertaken
 - b) The project should be kept on hold
 - c) The project should not be undertaken
 - d) Insufficient data

7. A Black Belt uses classical QFD matrix to understand his customer needs and wishes to outline the important service features. Out of 7 features, four features have a raw score of 120, and 3 have a raw score of 85. What should the assessment of the Black Belt?
- a) Features are confounded
 - b) Features may or may not meet customer needs correctly
 - c) Features having higher raw scores need to be considered for the project
 - d) None of the above

1. d) None of the above.
2. d) Benchmarking if not done correctly results in duplication of other company's best practices, which further stifles creativity.
3. a) QFD works best when used in define stage.
4. d) Design for cost is one of the key design for production principles.
5. d) Focus groups is considered the best VOC comments collection tool.
6. c) A project having negative NPV should not be undertaken.
7. c) Always the higher raw scores in a classical QFD approach are given more weight than others.

Thank You