Projex Academy

Design For Six Sigma



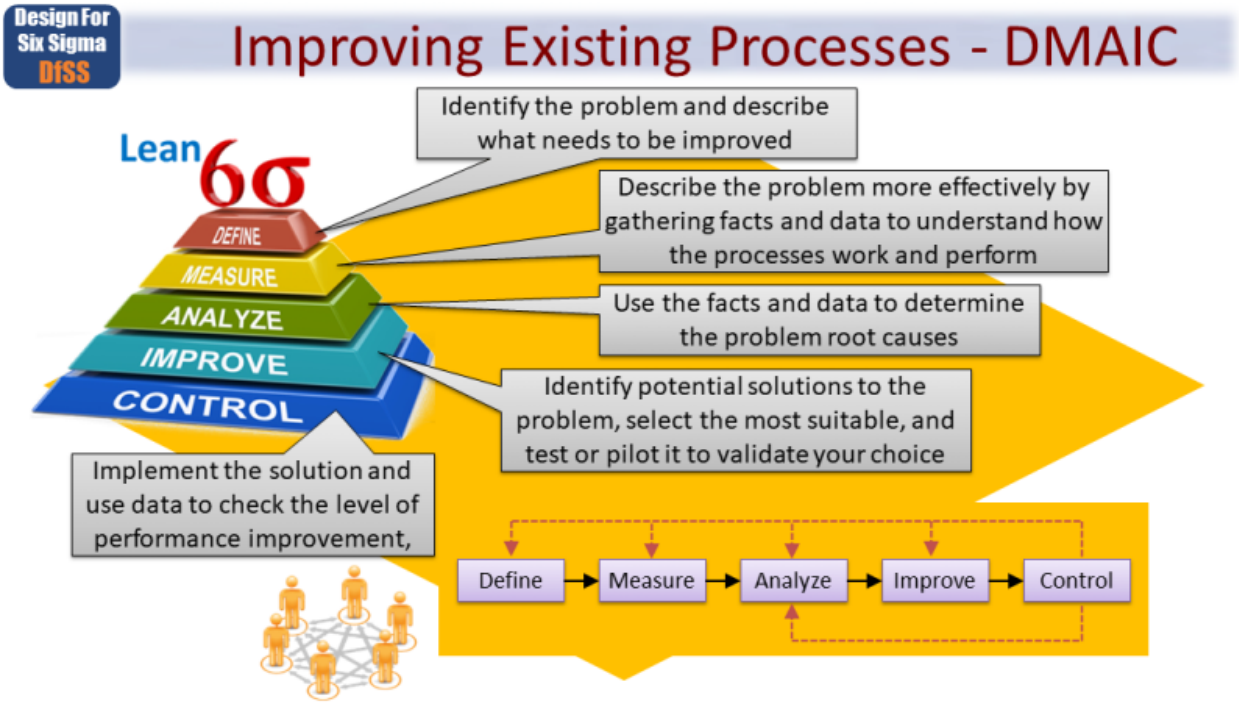
Harnessing the Power of DMADV

David Geoffrey Litten

DMADV

Design for Six Sigma

Before we get into Design for Six Sigma (which is for **new** processes, products, or services), first let's check out how Lean Six Sigma deals with **existing** processes:



Improving Existing Processes – DMAIC

DEFINE: Identify the problem and describe what needs to be improved

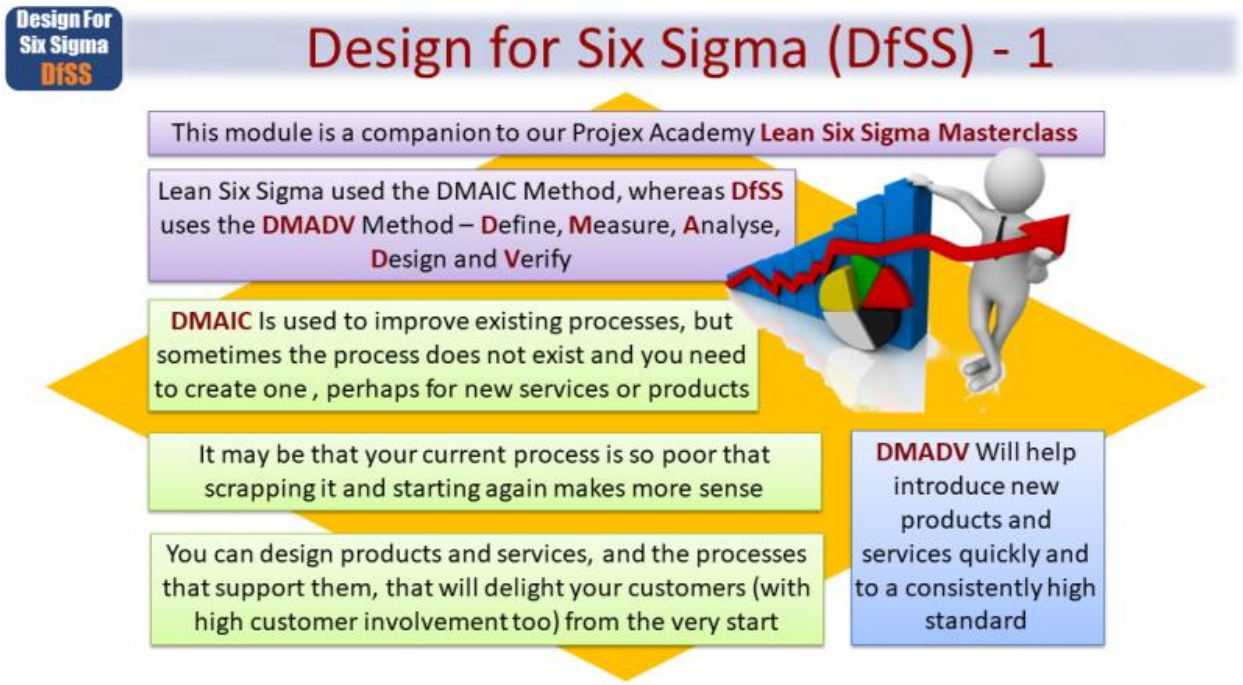
MEASURE: Describe the problem more effectively by gathering facts and data to understand how the processes work and perform

ANALYZE: Use the facts and data to determine the problem's root causes

IMPROVE: Identify potential solutions to the problem, select the most suitable, and test or pilot it to validate your choice

CONTROL: Implement the solution and use data to check the level of performance improvement,

Design for Six Sigma (DfSS)



These modules are a companion to our Projex Academy Lean Six Sigma Masterclass:
Lean Six Sigma used the DMAIC Method, whereas DfSS uses the DMADV Method – Define, Measure, Analyse, Design, and Verify

DMAIC Is used to improve existing processes, but sometimes the process does not exist, and you need to create one, perhaps for new services or products

It may be that your current process is so poor that scrapping it and starting again makes more sense! DMADV Will help introduce new products and services quickly and to a consistently high standard

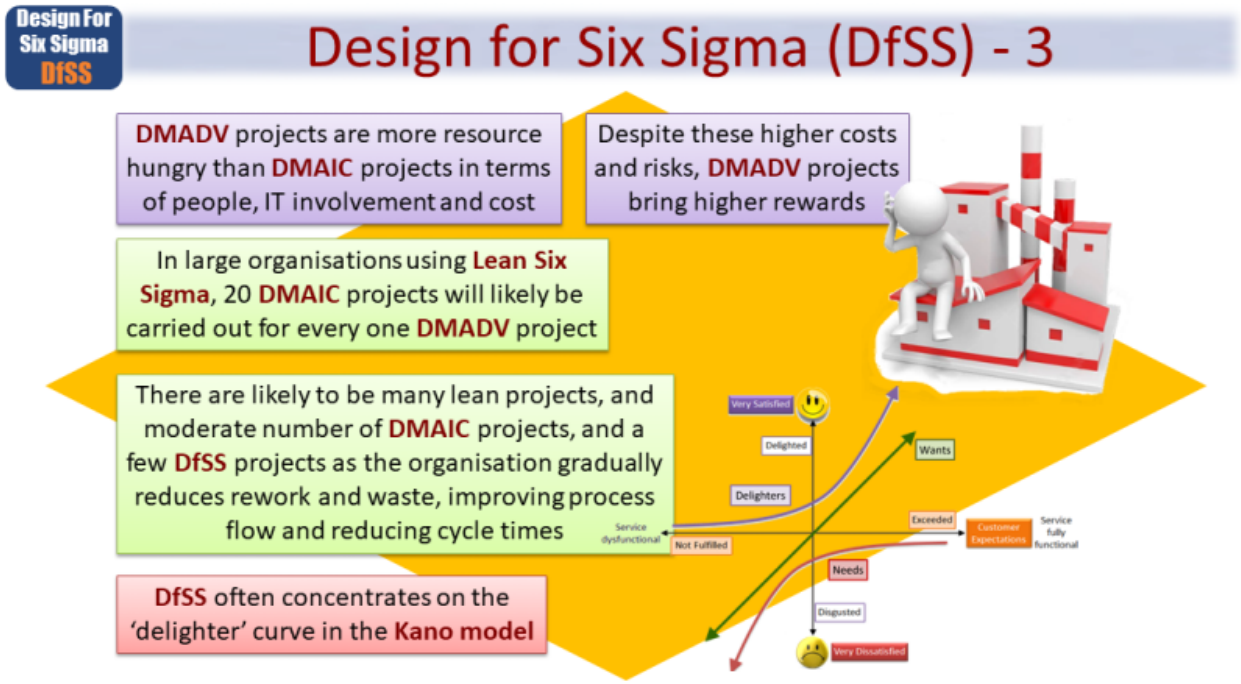


When redesigning a process we focus on the customer, when designing a new service or product there may not be a customer yet, so we focus on the demands of the (potential) marketplace

Where the customer is involved, this means both end-user customers and internal business stakeholders and users

Customer requirements and the resulting CTQ' s are established early on and the DMADV framework ensures that these requirements are satisfied in the final product, service, or process

As with DMAIC, we managed by facts and not speculation to ensure that new designs reflect customer CTQs and provide real value to the customers

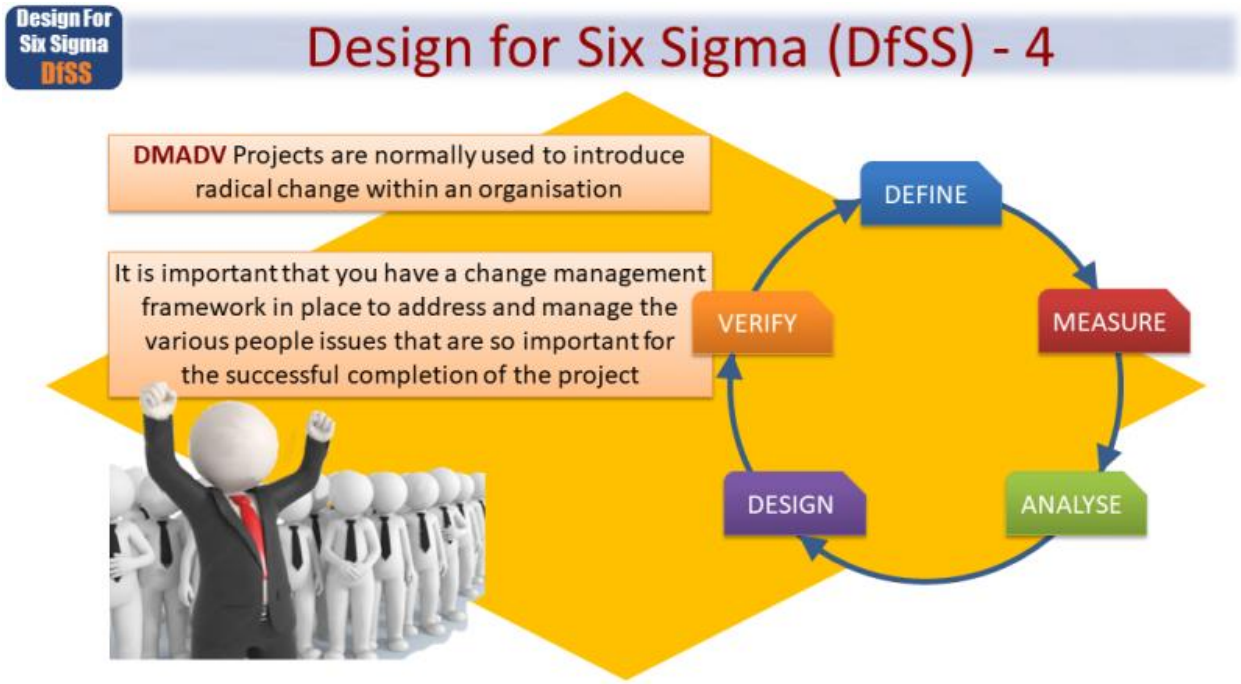


DMADV projects are more resource hungry than DMAIC projects in terms of people, IT involvement, and cost

Despite these higher costs and risks, DMADV projects bring higher rewards In large organizations using Lean Six Sigma, 20 DMAIC projects will likely be carried out for everyone

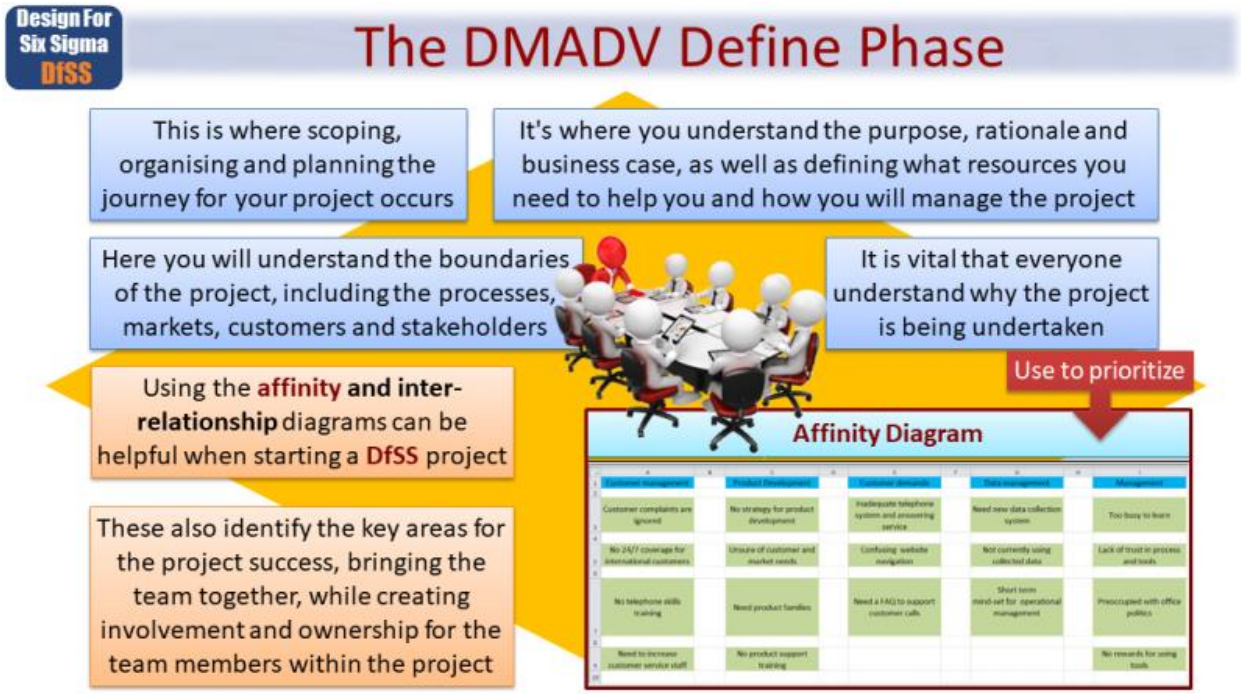
DMADV project

There are likely to be many lean projects, a moderate number of DMAIC projects, and a few DfSS projects as the organization gradually reduces rework and waste, improving process flow and reducing cycle times. DfSS often concentrates on the 'delighter' curve in the Kano model



DMADV Projects are normally used to introduce radical change within an organization.

It is important that you have a change management framework in place to address and manage the various people issues that are so important for the successful completion of the project



The DMADV Define Phase

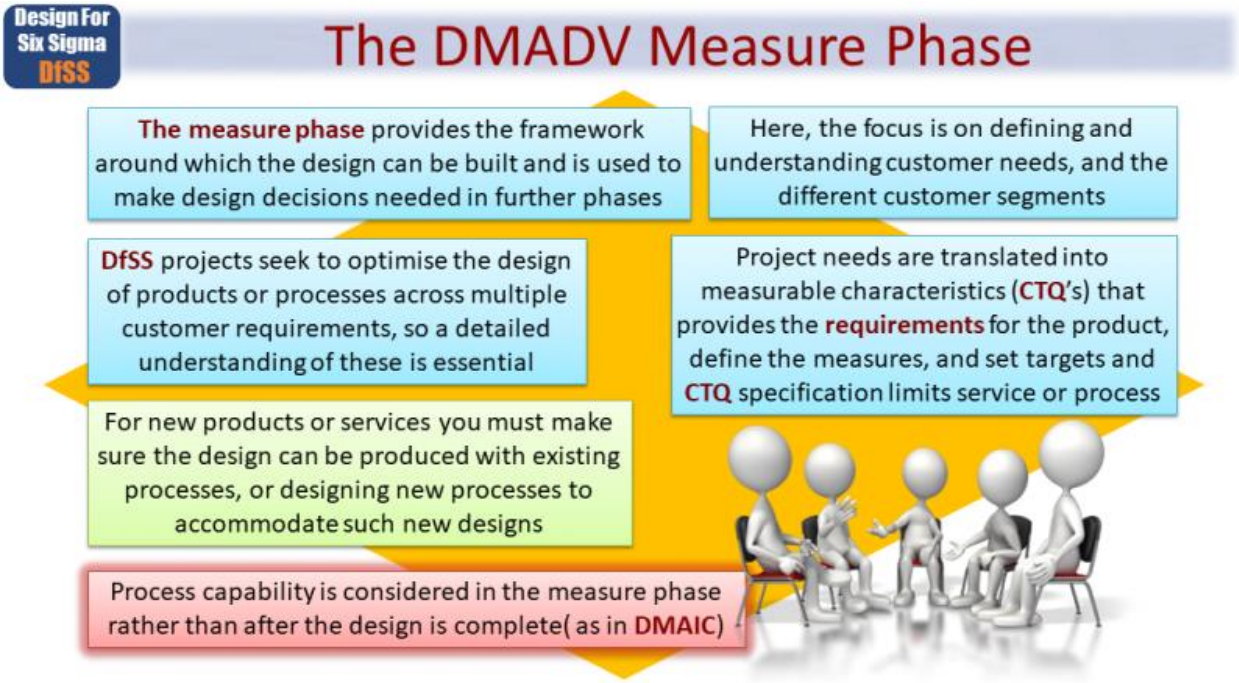
This is where scoping, organizing, and planning the journey for your project occurs

It's where you understand the purpose, rationale, and business case, as well as define what resources you need to help you and how you will manage the project

Here you will understand the boundaries of the project, including the processes, markets, customers, and stakeholders. It is vital that everyone understand why the project is being undertaken.

Using the affinity and inter-relationship diagrams can be helpful when starting a DfSS project

These also identify the key areas for the project's success, bringing the team together, while creating involvement and ownership for the team members within the project



The DMADV Measure Phase

The measure phase provides the framework around which the design can be built and is used to make design decisions needed in further phases

Here, the focus is on defining and understanding customer needs, and the different customer segments

DfSS projects seek to optimize the design of products or processes across multiple customer requirements, so a detailed understanding of these is essential

Project needs are translated into measurable characteristics (CTQ's) that provides the requirements for the product, define the measures, and set targets, and CTQ specification limits service or process

For new products or services, you must make sure the design can be produced with existing processes or designing new processes to accommodate such new designs

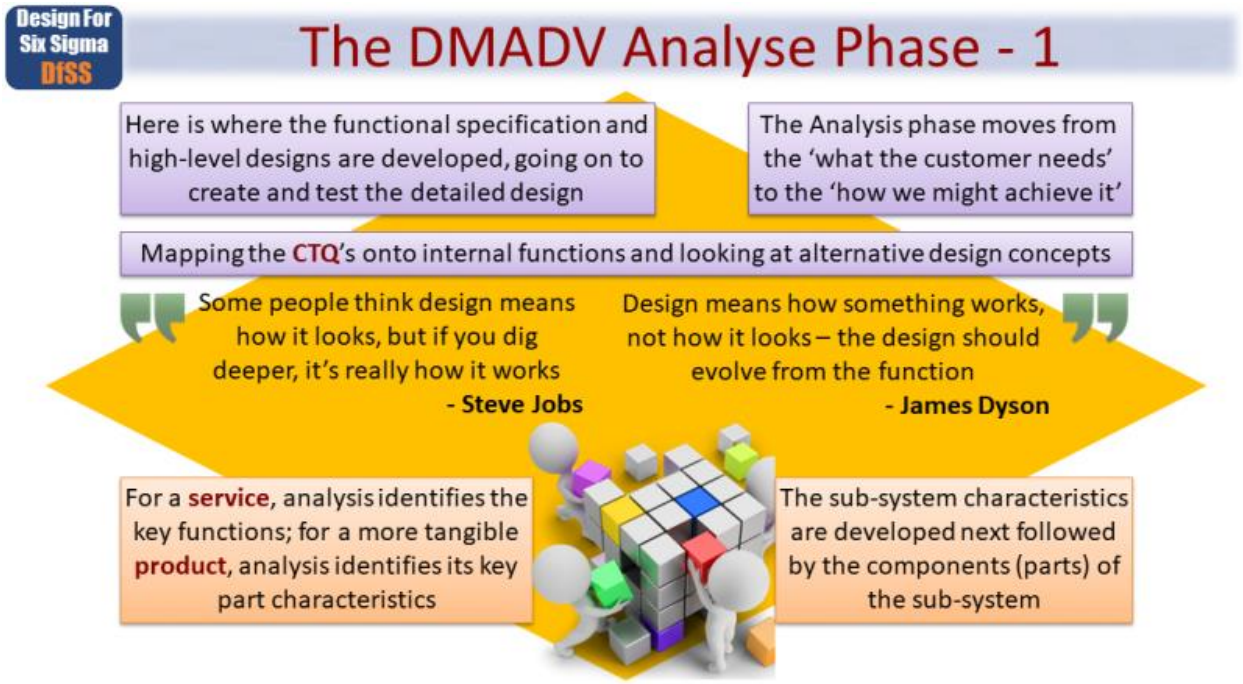
Process capability is considered in the measure phase rather than after the design is complete (as in DMAIC)

The DMADV Analyse Phase

Here is where the functional specification and high-level designs are developed, going on to create and test the detailed design

The Analysis phase moves from the 'what the customer needs' to the 'how we might achieve it'

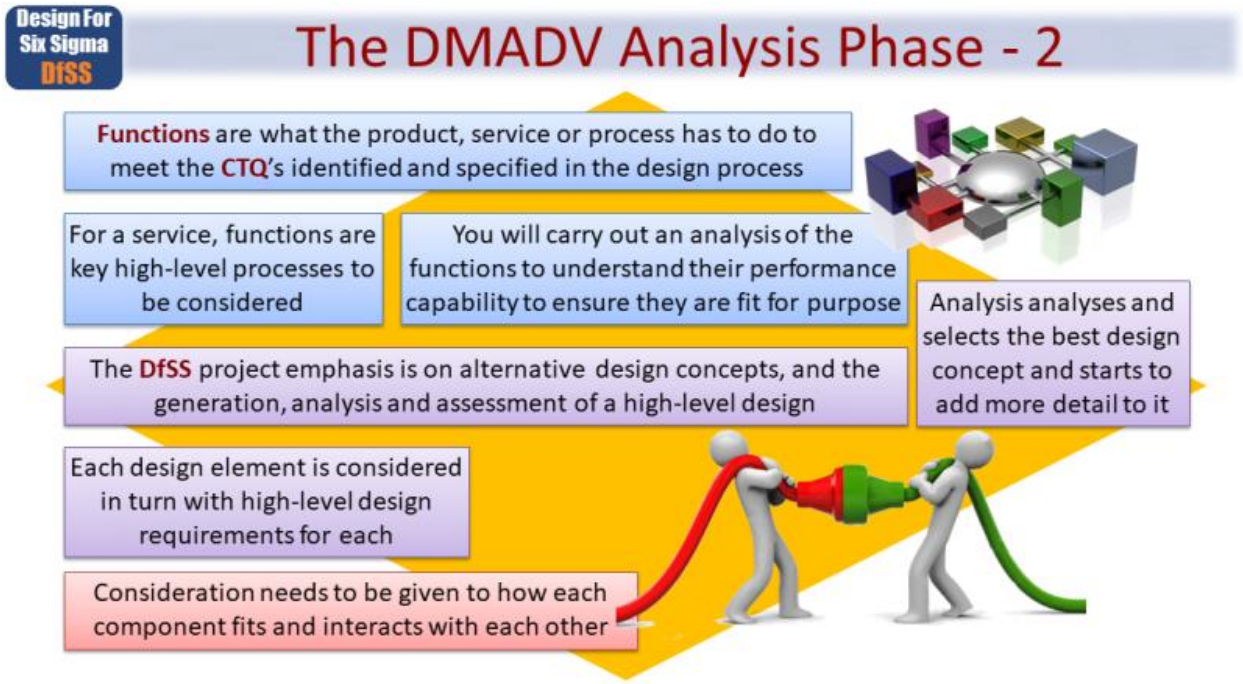
Mapping the CTQs onto internal functions and looking at alternative design concepts



"Some people think design means how it looks, but if you dig deeper, it's really how it works"
Steve Jobs

"Design means how something works, not how it looks – the design should evolve from the function"
James Dyson

For a service, the analysis identifies the key functions; for a more tangible product, the analysis identifies its key part characteristics. The sub-system characteristics are developed next followed by the components (parts) of the sub-system

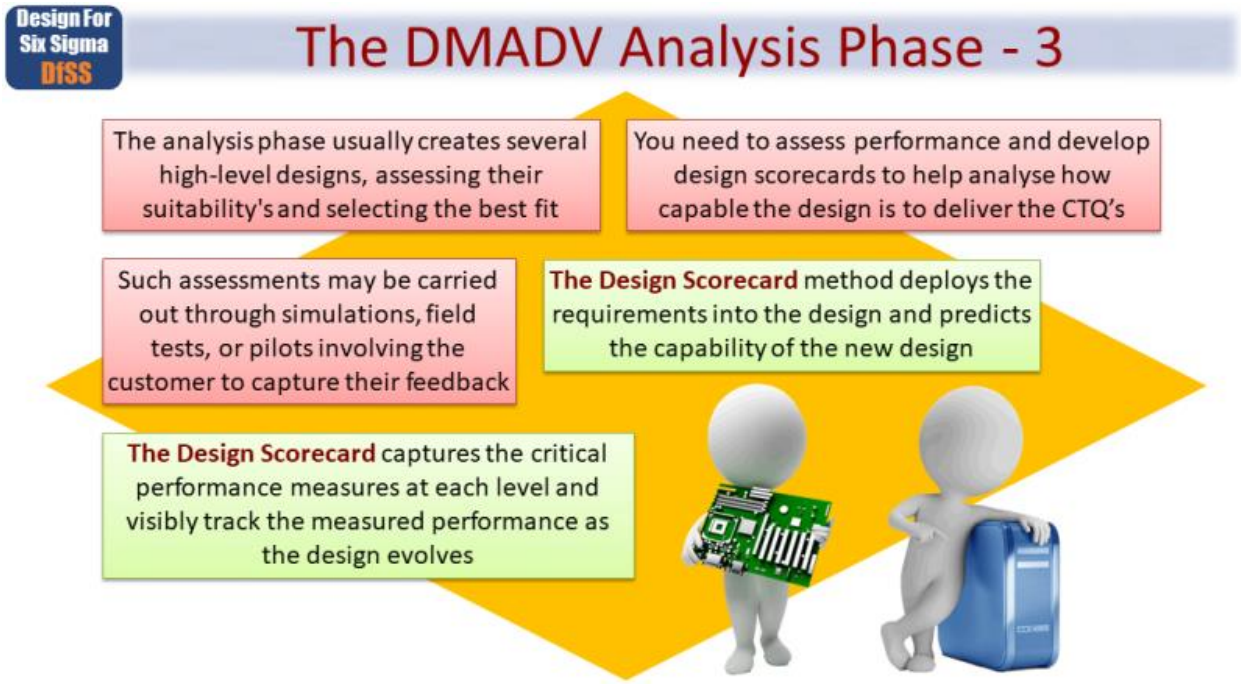


Functions are what the product, service or process must do to meet the CTQs identified and specified in the design process

For a service, functions are key high-level processes to be considered
You will carry out an analysis of the functions to understand their performance capability to ensure they are fit for the purpose

The DfSS project emphasis is on alternative design concepts and the generation, analysis, and assessment of a high-level design. Analysis analyses and selects the best design concept and starts to add more detail to it

Each design element is considered in turn with high-level design requirements for each. Consideration needs to be given to how each component fits and interacts with each other



The analysis phase usually creates several high-level designs, assessing their suitability and selecting the best fit

You need to assess performance and develop design scorecards to help analyze how capable the design is to deliver the CTQs. Such assessments may be carried out through simulations, field tests, or pilots involving the customer to capture their feedback

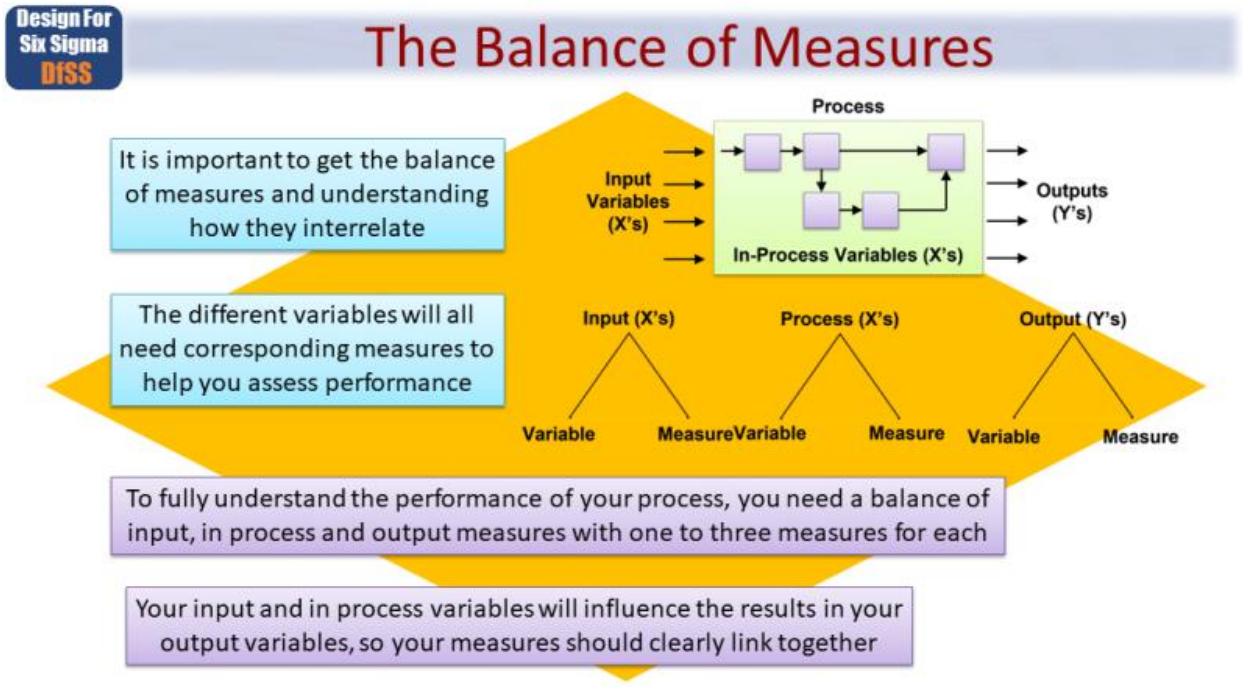
The Design Scorecard method deploys the requirements into the design and predicts the capability of the new design. The Design Scorecard captures the critical performance measures at each level and visibly tracks the measured performance as the design evolves

The Balance of Measures

It is important to get the balance of measures and understand how they interrelate.

The different variables will all need corresponding measures to help you assess performance. To fully understand the performance of your process, you need a balance of input, in-process, and output measures with one to

three measures for each. Your input and in-process variables will influence the results in your output variables, so your measures should clearly link together

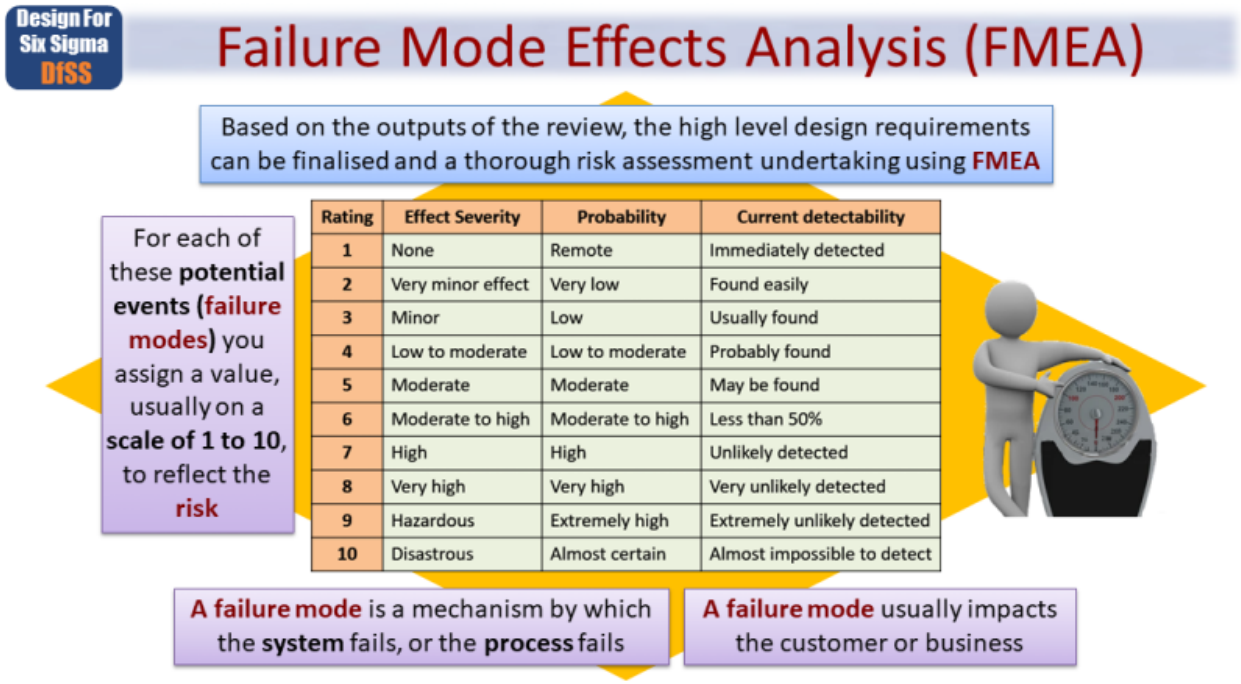


Failure Mode Effects Analysis (FMEA)

Based on the outputs of the review, the high-level design requirements can be finalized, and a thorough risk assessment undertaken using FMEA. For each of these potential events (failure modes), you assign a value, usually on a scale of 1 to 10, to reflect the risk

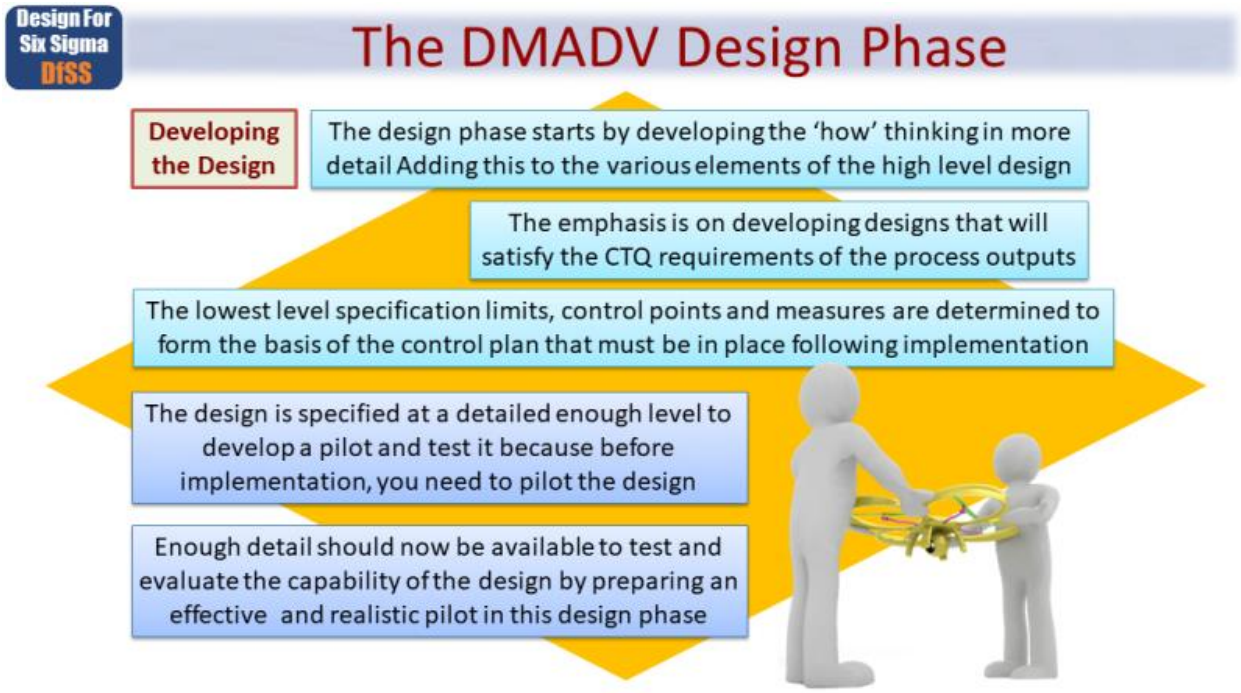
A failure mode is a mechanism by which the system fails, or the process fails.

A failure mode usually impacts the customer or business



The DMADV Design Phase

Developing the Design



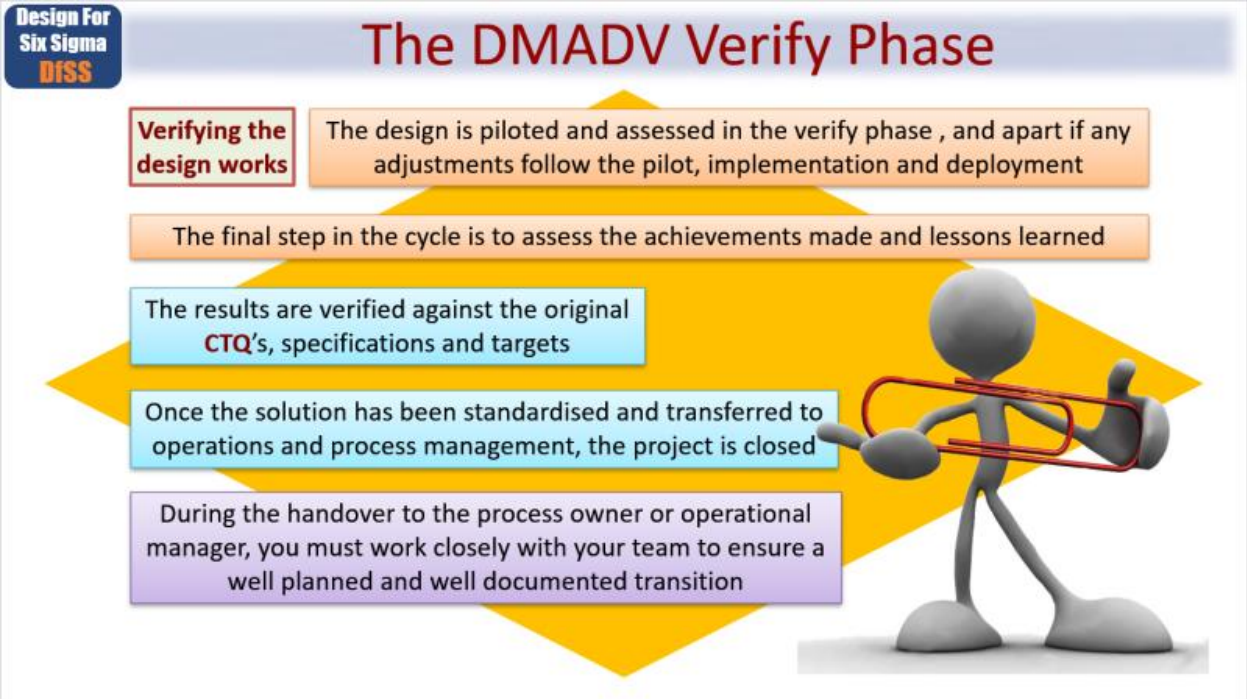
The design phase starts by developing the 'how' thinking in more detail Adding this to the various elements of the high-level design. The emphasis is

on developing designs that will satisfy the CTQ requirements of the process outputs.

The lowest level specification limits, control points, and measures are determined to form the basis of the control plan that must be in place following the implementation

The design is specified at a detailed enough level to develop a pilot and test it because, before implementation, you need to pilot the design. Enough detail should now be available to test and evaluate the capability of the design by preparing an effective and realistic pilot in this design phase

The DMADV Verify Phase
Verifying the design works



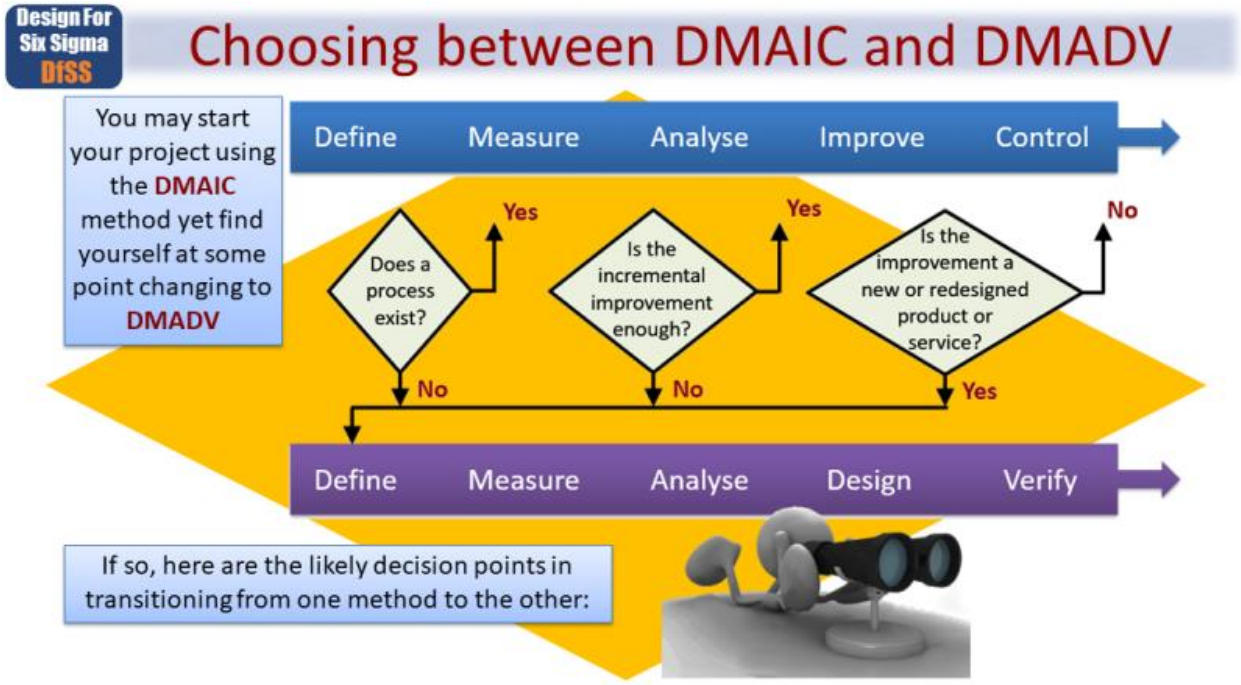
The design is piloted and assessed in the verify phase, and apart if any adjustments following the pilot, implementation, and deployment.

The final step in the cycle is to assess the achievements made and lessons learned

The results are verified against the original CTQs, specifications and targets. Once the solution has been standardized and transferred to operations and process management, the project is closed.

During the handover to the process owner or operational manager, you must work closely with your team to ensure a well-planned and well-documented transition

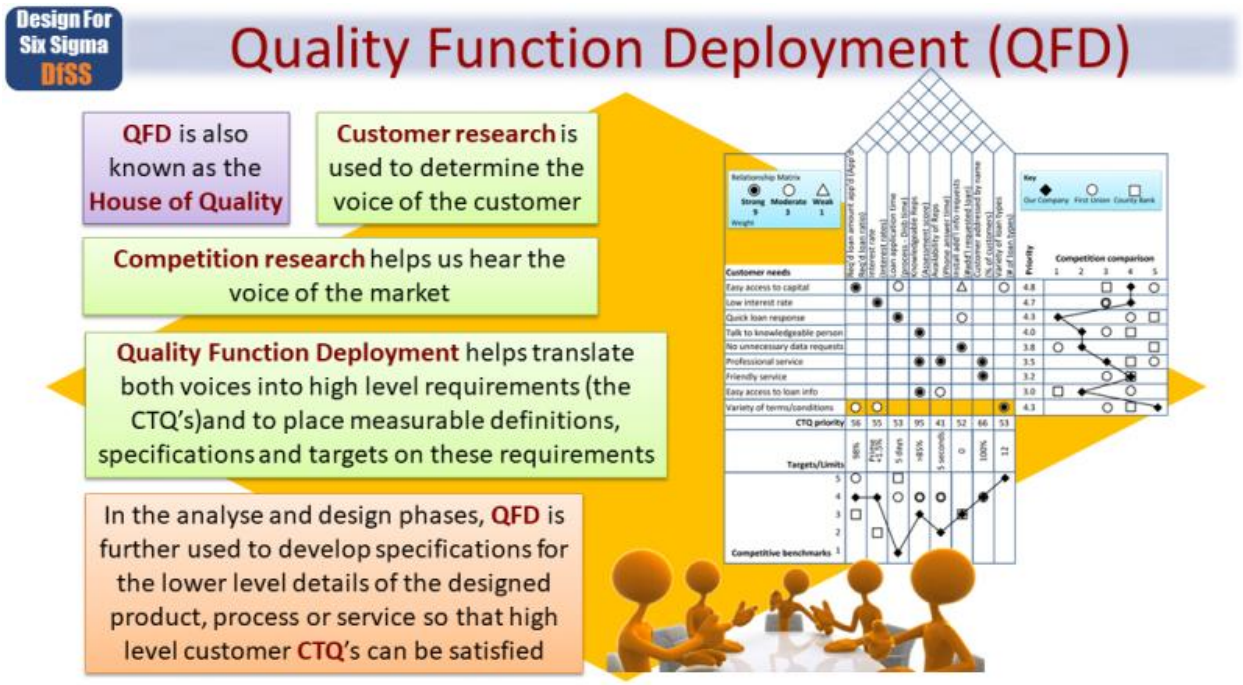
Choosing between DMAIC and DMADV



You may start your project using the DMAIC method yet find yourself at some point changing to DMADV

If so, here are the likely decision points in transitioning from one method to the other:

Quality Function Deployment (QFD)

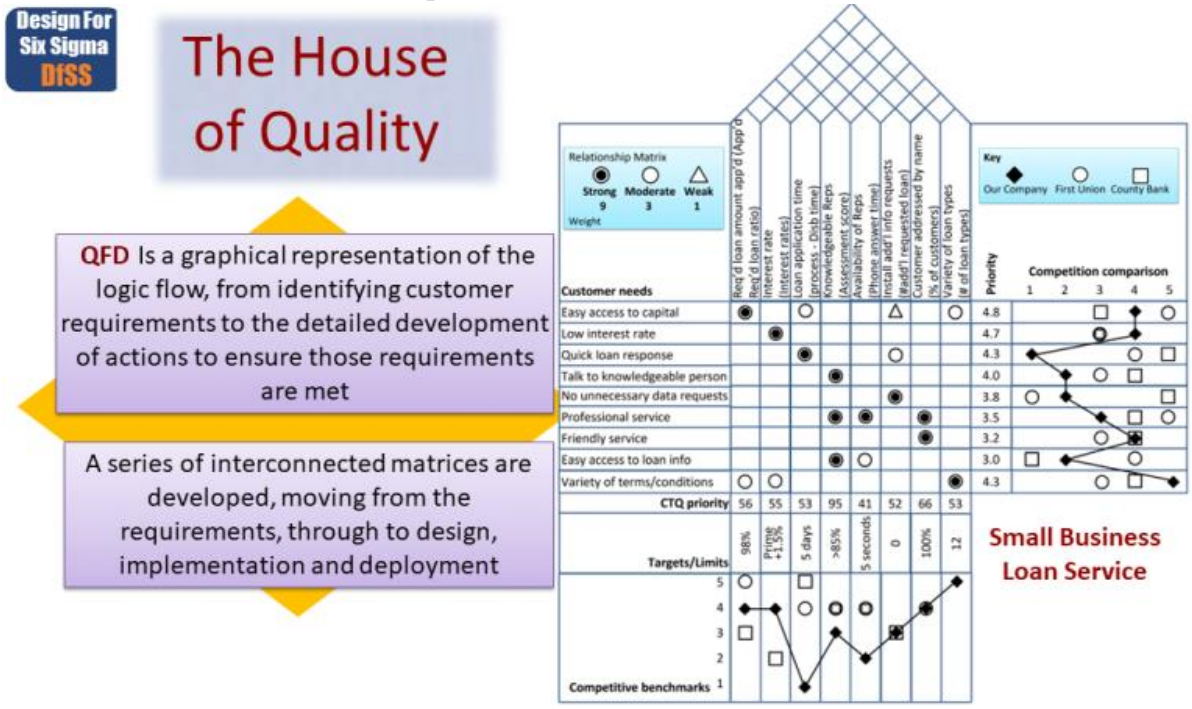


QFD is also known as the House of Quality

Customer research is used to determine the voice of the customer. Competition research helps us hear the voice of the market. Quality Function Deployment helps translate both voices into high-level requirements (the CTQs) and to place measurable definitions, specifications, and targets on these requirements.

In the analysis and design phases, QFD is further used to develop specifications for the lower-level details of the designed product, process, or service so that high-level customer CTQs can be satisfied

The House of Quality



QFD Is a graphical representation of the logic flow, from identifying customer requirements to the detailed development of actions to ensure those requirements are met. A series of interconnected matrices are developed, moving from the requirements, through to design, implementation, and deployment



The House of Quality "room numbers ", represent the logic flow order for completing the QFD

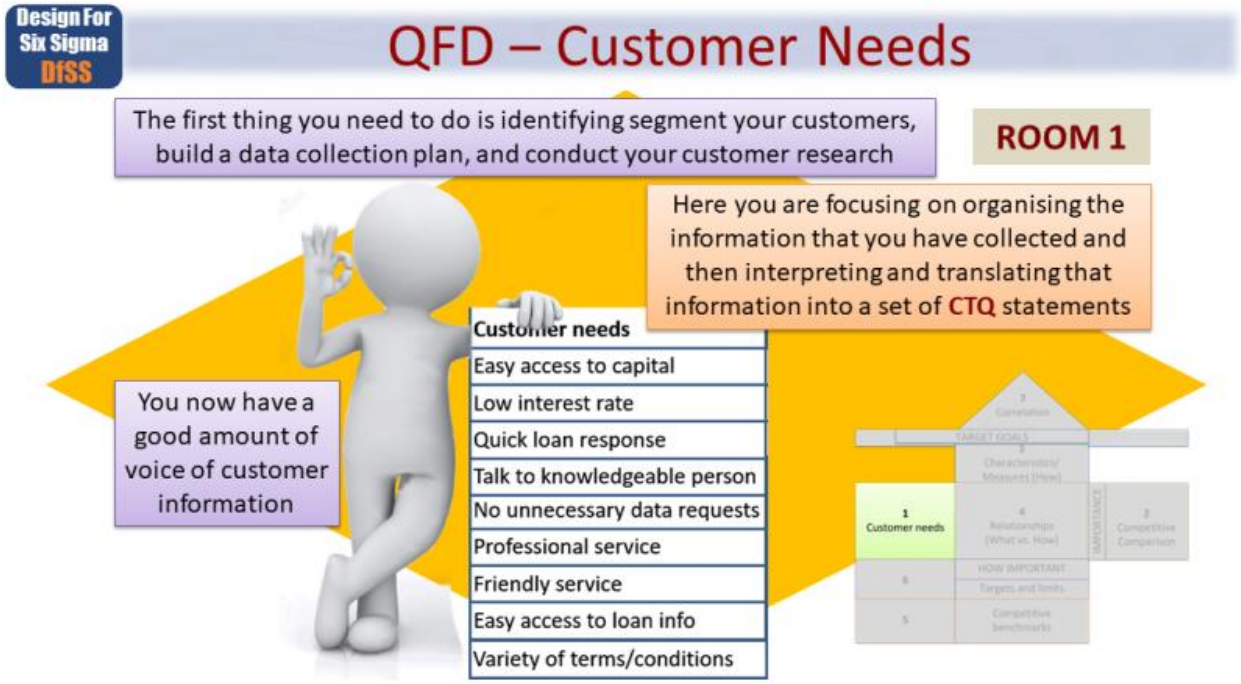
I will now take you through each "room" in more detail …

QFD – Customer Needs ROOM 1

The first thing you need to do is identify and segment your customers, build a data collection plan, and conduct your customer research.

You now have a good amount of voice of customer information.

Here you are focusing on organizing the information that you have collected and then interpreting and translating that information into a set of CTQ statements



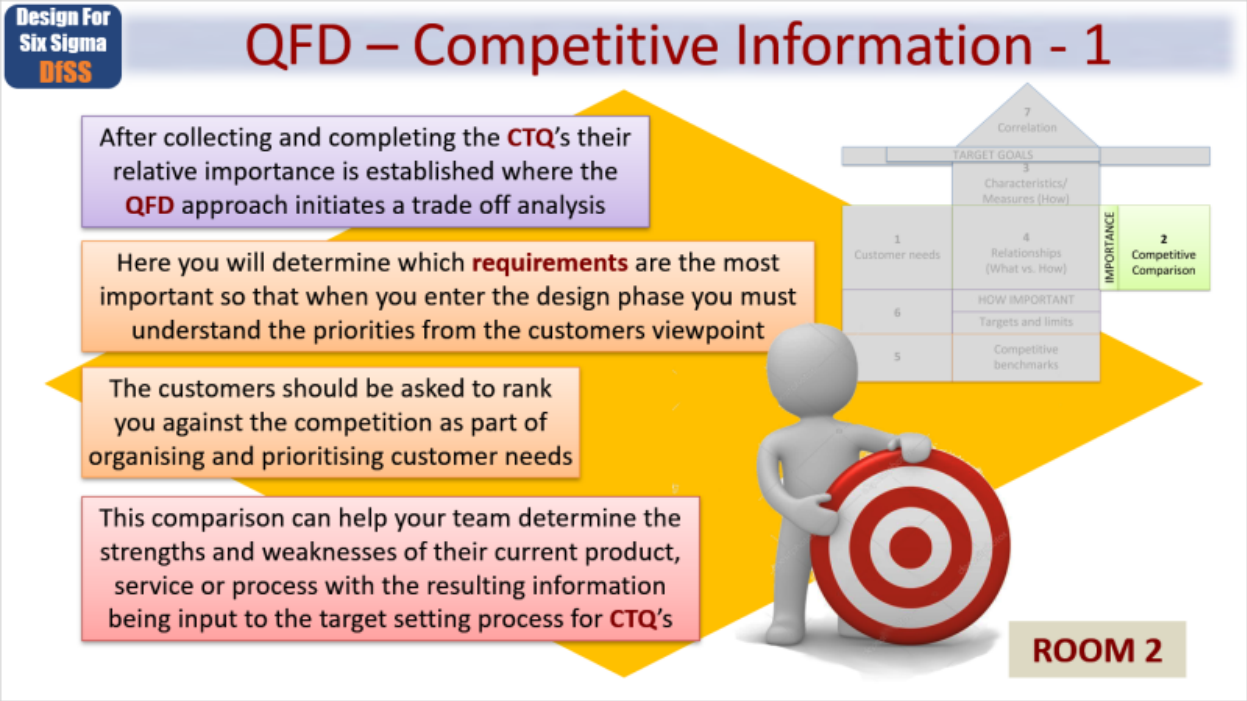
QFD – Competitive Information ROOM 2

After collecting and completing the CTQ's their relative importance is established where the QFD approach initiates a trade-off analysis.

Here you will determine which requirements are the most important so that when you enter the design phase you must understand the priorities from the customers' viewpoint.

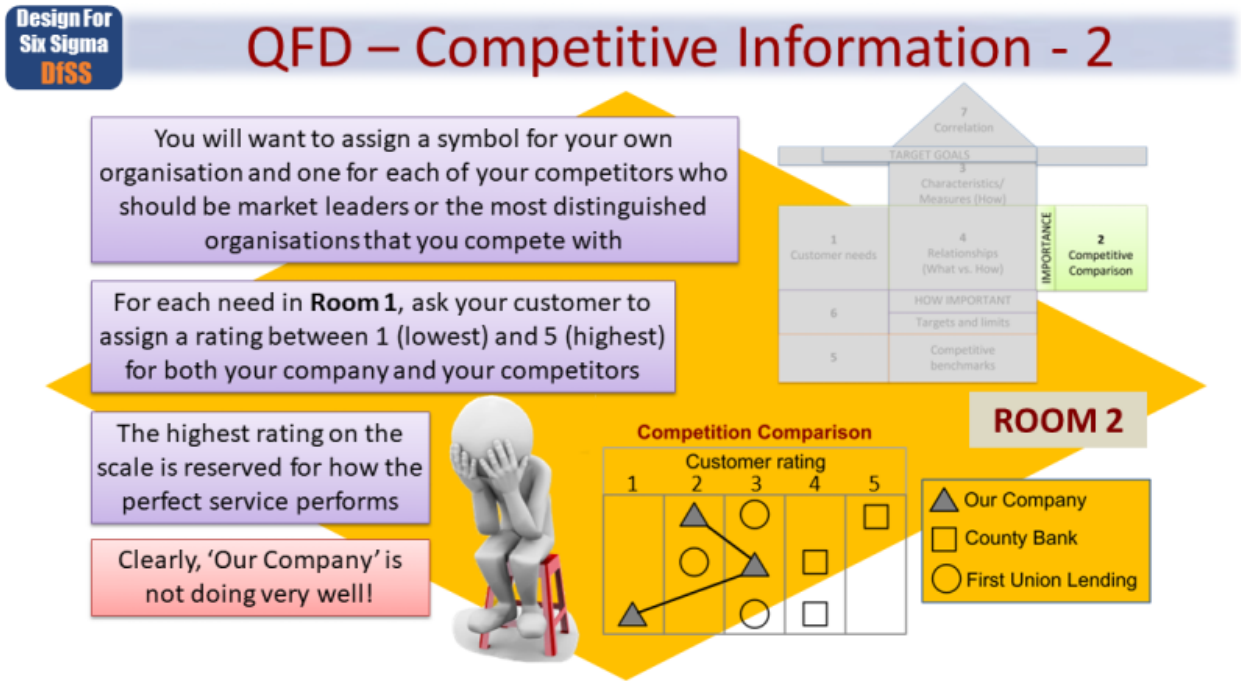
The customers should be asked to rank you against the competition as part of organizing and prioritizing customer needs.

This comparison can help your team determine the strengths and weaknesses of their current product, service, or process with the resulting information being input to the target setting process for CTQs



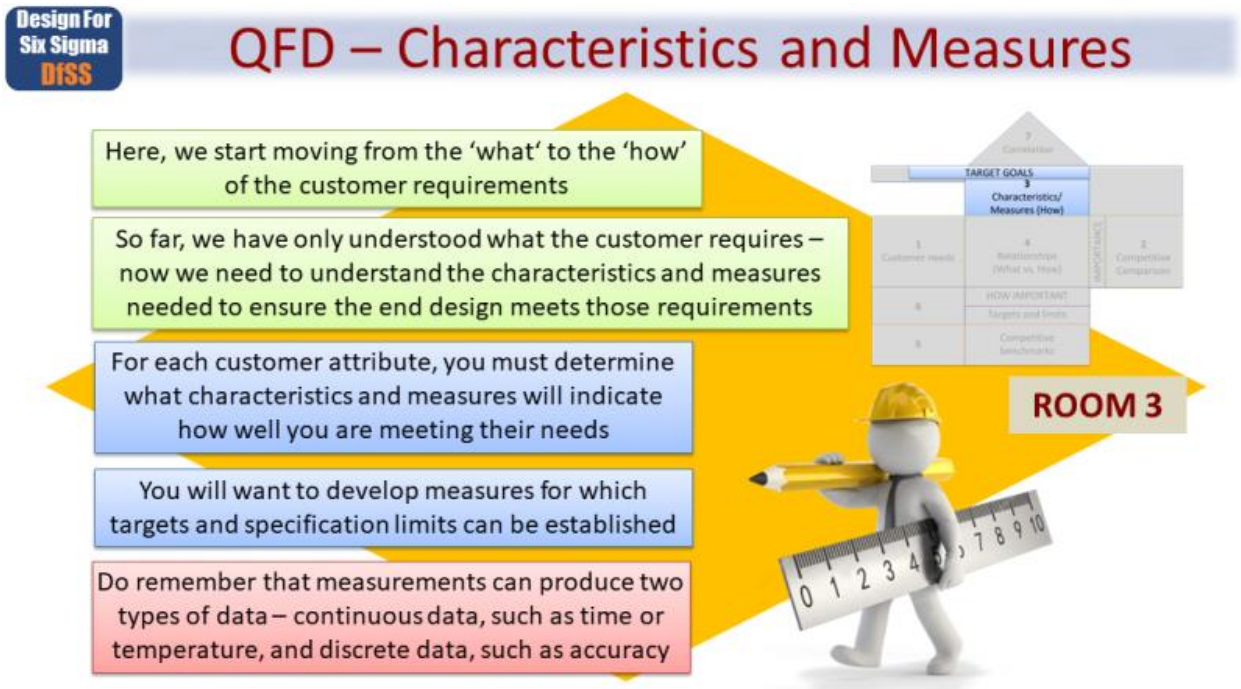
You will want to assign a symbol for your own organization and one for each of your competitors who should be market leaders or the most distinguished organizations that you compete with.

For each need in Room 1, ask your customer to assign a rating between 1 (lowest) and 5 (highest) for both your company and your competitors



The highest rating on the scale is reserved for how the perfect service performs. Clearly, 'Our Company' is not doing very well!

QFD – Characteristics and Measures ROOM 3



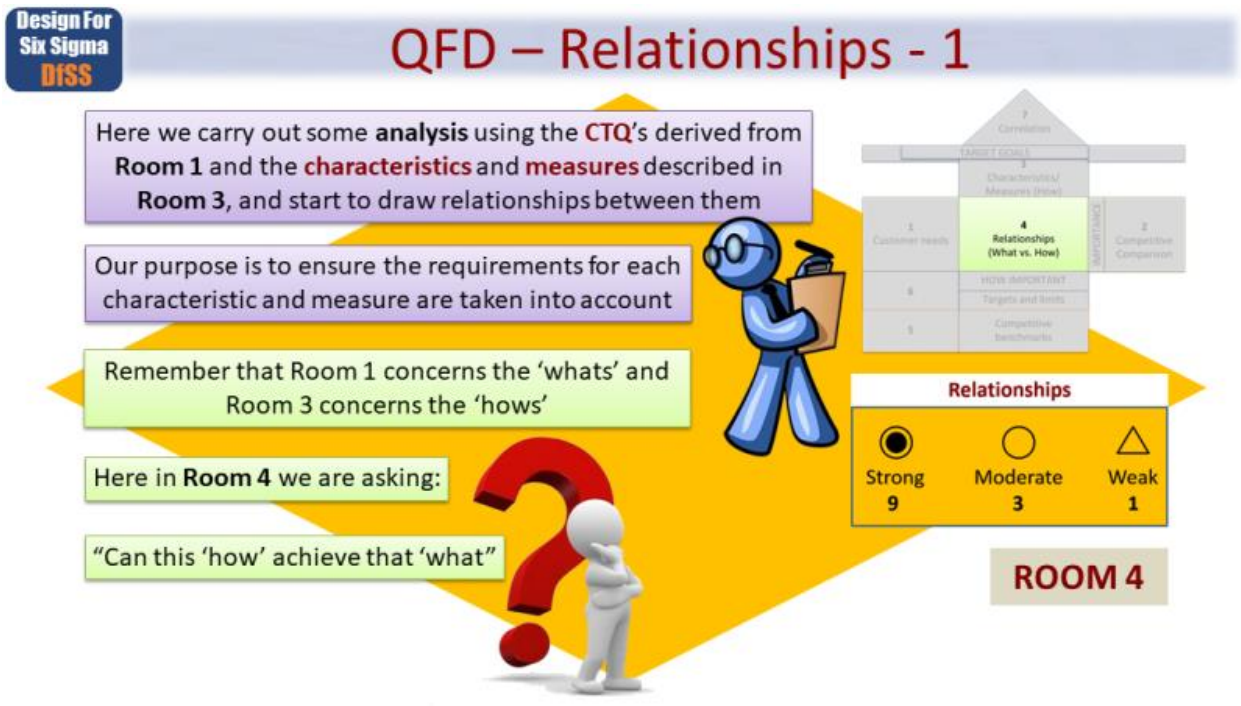
Here, we start moving from the 'what' to the 'how' of the customer requirements. So far, we have only understood what the customer requires – now we need to understand the characteristics and measures needed to ensure the end design meets those requirements.

For each customer attribute, you must determine what characteristics and measures will indicate how well you are meeting their needs.

You will want to develop measures for which targets and specification limits can be established.

Do remember that measurements can produce two types of data – continuous data, such as time or temperature, and discrete data, such as accuracy

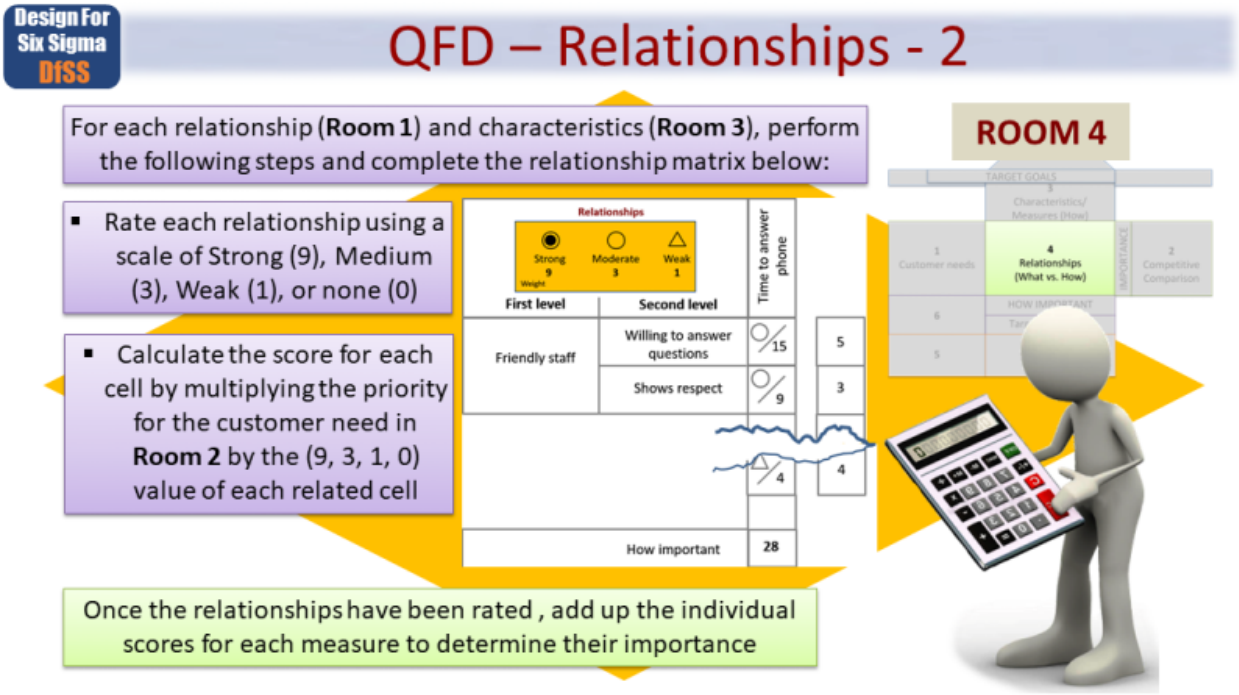
QFD – Relationships ROOM 4



Here we carry out some analysis using the CTQs derived from Room 1 and the characteristics and measures described in Room 3 and start to draw relationships between them.

Our purpose is to ensure the requirements for each characteristic and measure are considered. Remember that Room 1 concerns the 'whats' and Room 3 concerns the 'hows'

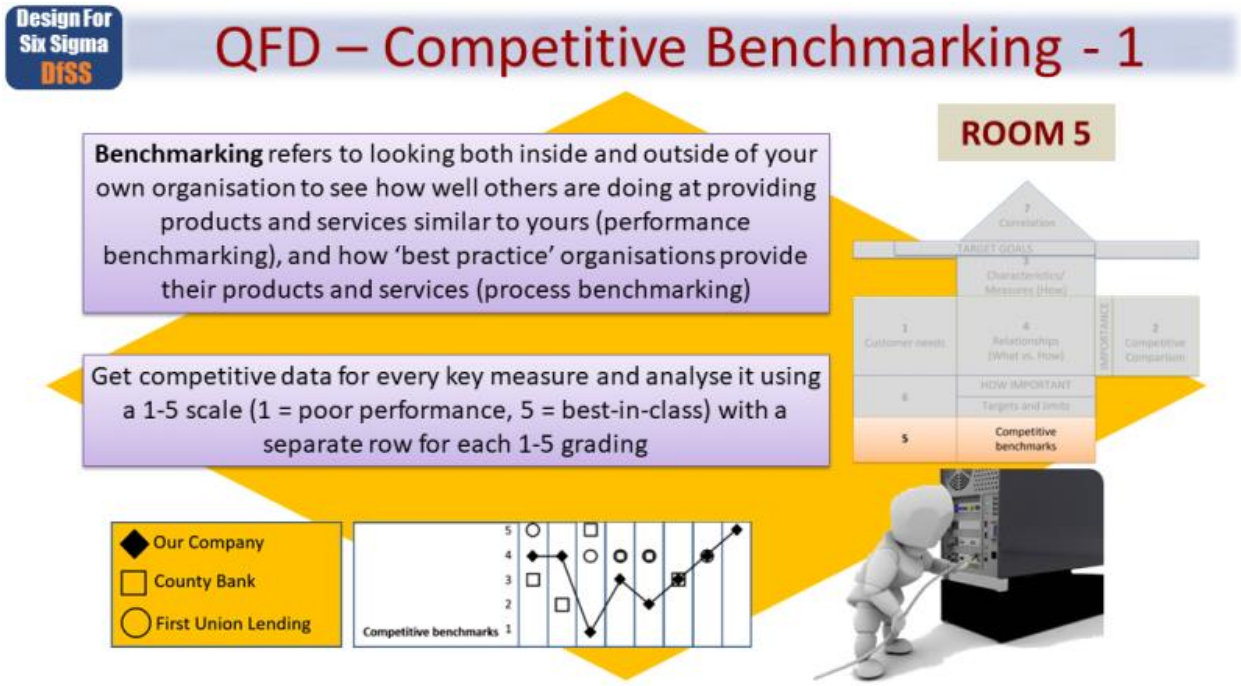
Here in Room 4, we are asking: "Can this 'how' achieve that 'what"



For each relationship (Room 1) and characteristics (Room 3), perform the following steps and complete the relationship matrix below:

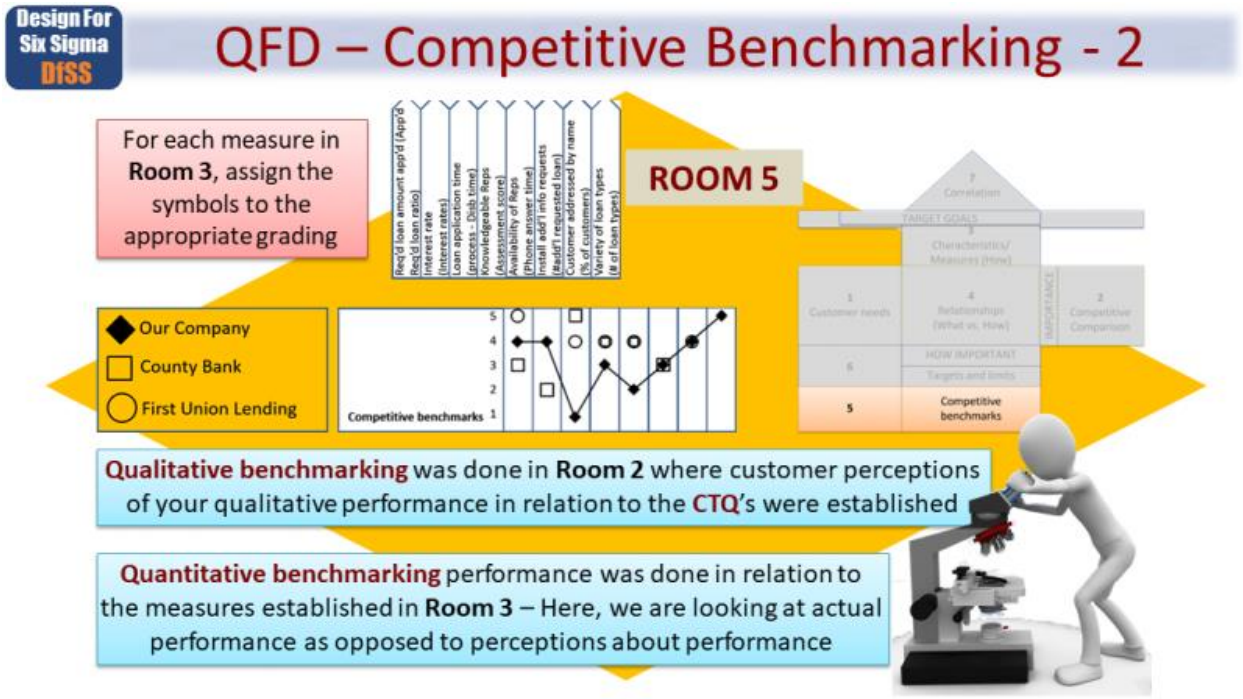
- Rate each relationship using a scale of Strong (9), Medium (3), Weak (1), or none (0)
- Calculate the score for each cell by multiplying the priority for the customer need in Room 2 by the (9, 3, 1, 0) value of each related cell
- Once the relationships have been rated, add up the individual scores for each measure to determine their importance

QFD – Competitive Benchmarking ROOM 5



Benchmarking refers to looking both inside and outside of your own organization to see how well others are doing at providing products and services like yours (performance benchmarking), and how 'best practice' organizations provide their products and services (process benchmarking).

Get competitive data for every key measure and analyze it using a 1-5 scale (1 = poor performance, 5 = best-in-class) with a separate row for each 1-5 grading

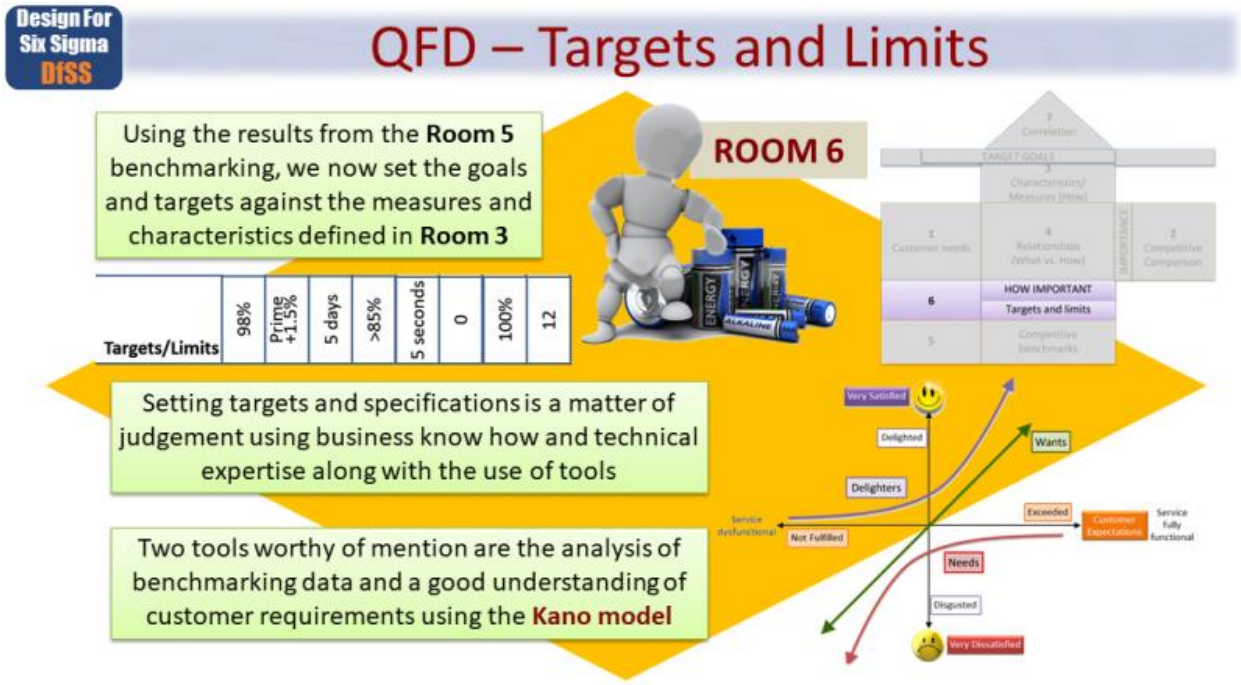


For each measure in Room 3, assign the symbols to the appropriate grading.

Qualitative benchmarking was done in Room 2 where customer perceptions of your qualitative performance in relation to the CTQ's were established.

Quantitative benchmarking performance was done in relation to the measures established in Room 3 – Here, we are looking at actual performance as opposed to perceptions about performance

QFD – Targets and Limits ROOM 6

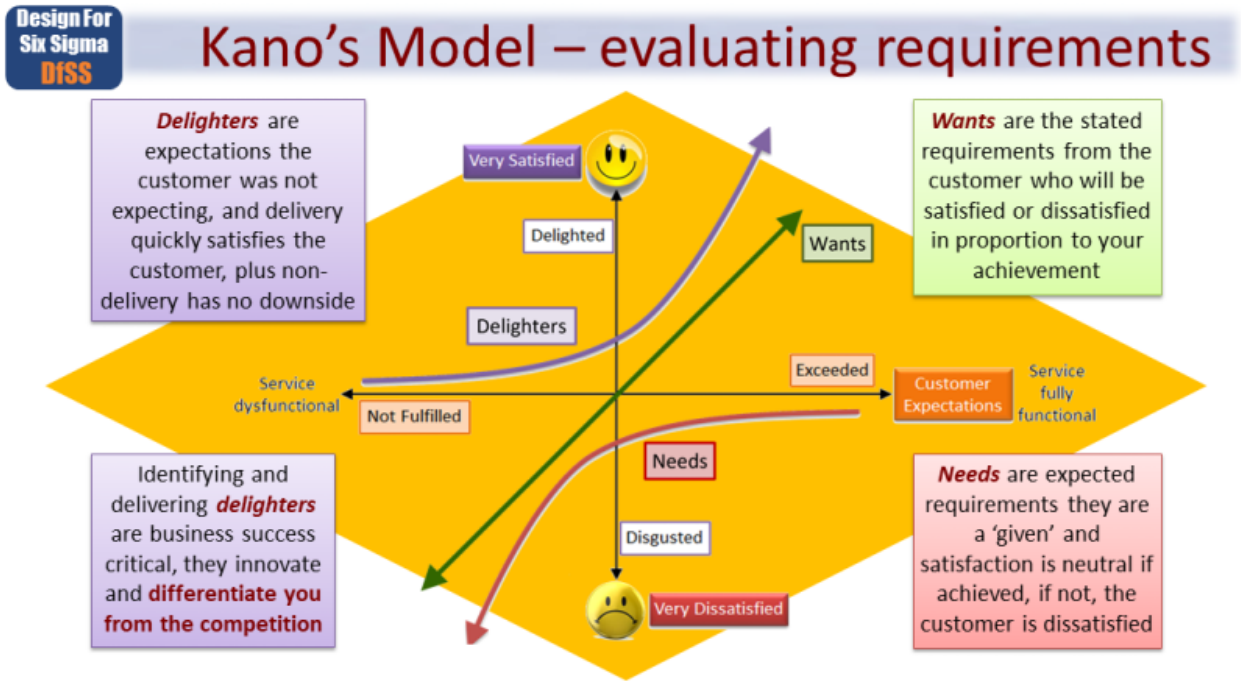


Using the results from the Room 5 benchmarking, we now set the goals and targets against the measures and characteristics defined in Room 3.

Setting targets and specifications is a matter of judgment using business know-how and technical expertise along with the use of tools.

Two tools worthy of mention are the analysis of benchmarking data and a good understanding of customer requirements using the Kano model.

Kano's Model – evaluating requirements



Delighters are expectations the customer was not expecting, and delivery quickly satisfies the customer, plus non-delivery has no downside.

Wants are the stated requirements from the customer who will be satisfied or dissatisfied in proportion to your achievement.

Identifying and delivering delighters are business success critical, they innovate and differentiate you from the competition.

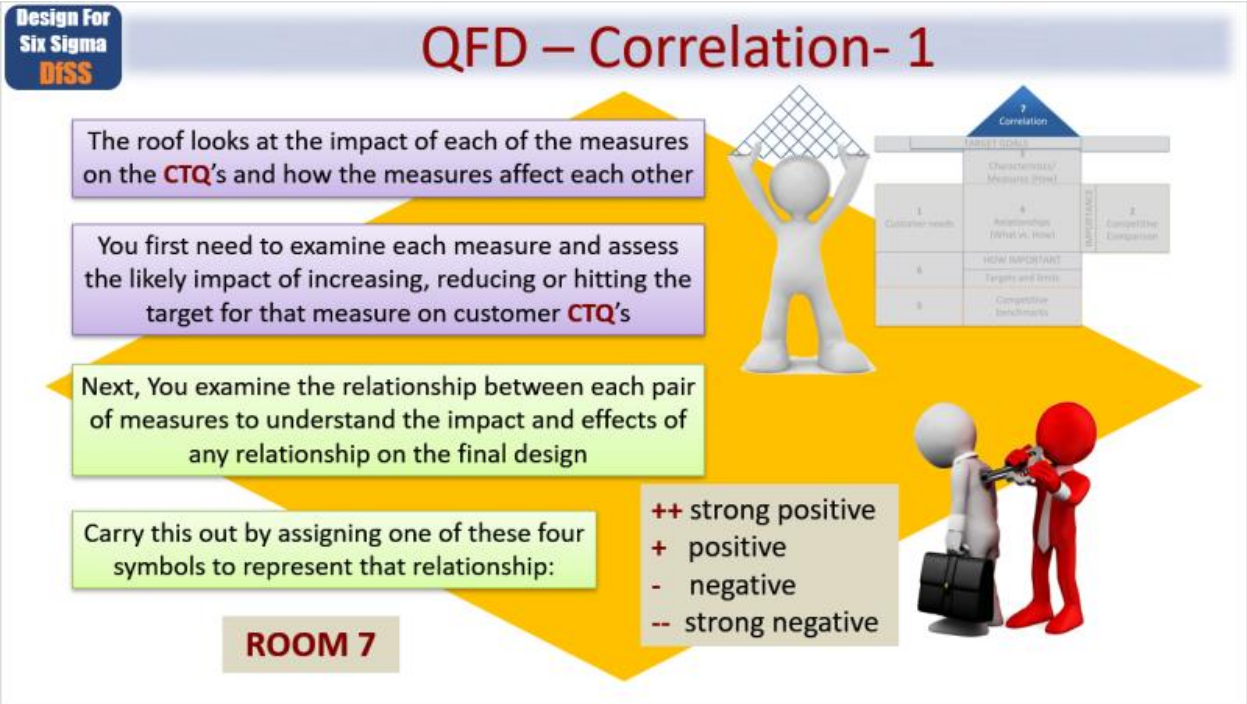
Needs are expected requirements they are a 'given' and satisfaction is neutral if achieved, if not, the customer is dissatisfied

QFD – Correlation ROOM 7

The roof looks at the impact of each of the measures on the CTQs and how the measures affect each other. You first need to examine each measure and assess the likely impact of increasing, reducing, or hitting the target for that measure on customer CTQs.

Next, you examine the relationship between each pair of measures to understand the impact and effects of any relationship on the final design. Carry this out by assigning one of these four symbols to represent that relationship:

++ strong positive, positive, negative, and — strong negative



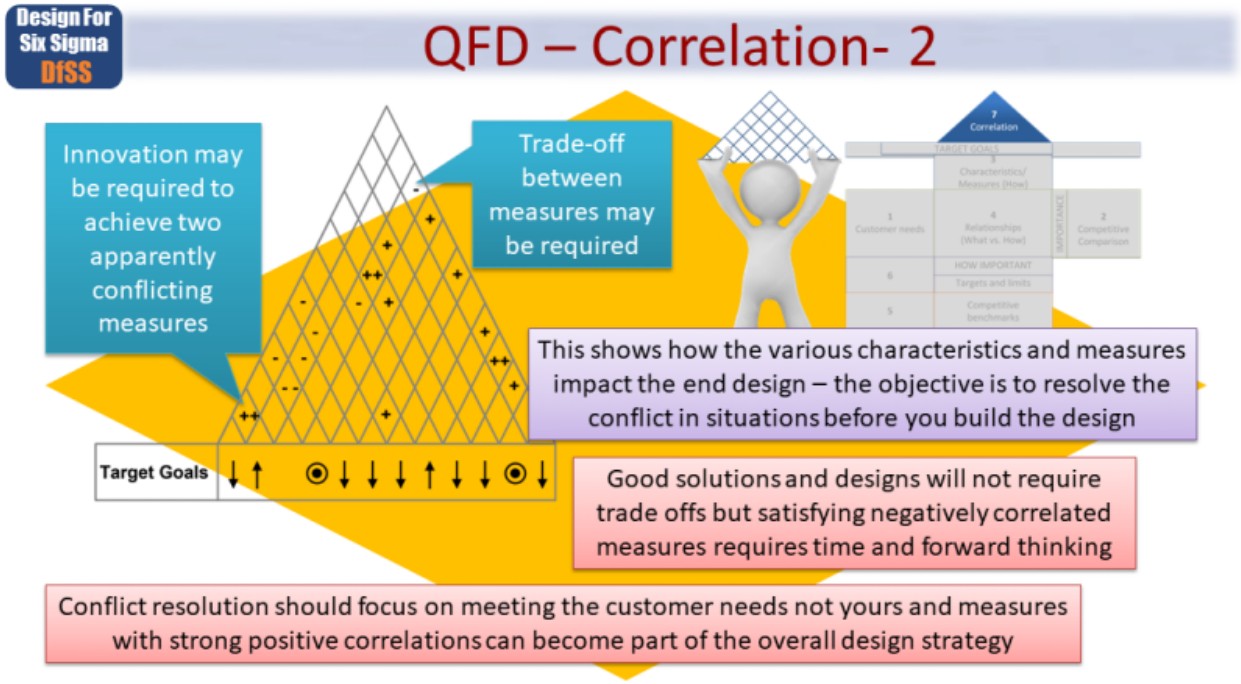
This shows how the various characteristics and measures impact the end design – the objective is to resolve the conflict in situations before you build the design.

Innovation may be required to achieve two apparently conflicting measures.

A trade-off between measures may be required.

Good solutions and designs will not require trade-offs but satisfying negatively correlated measures requires time and forward-thinking.

Conflict resolution should focus on meeting the customer's needs not yours and measures with strong positive correlations can become part of the overall design strategy



Developing more Houses of Quality

QFD Drill-down

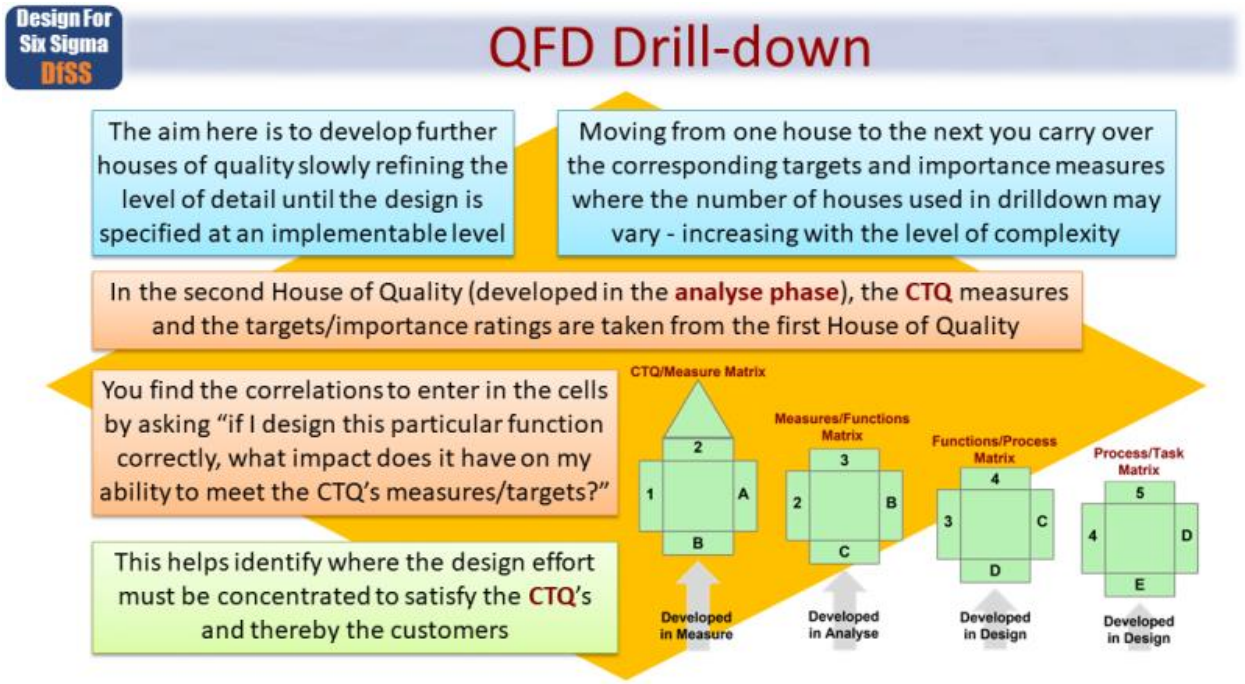
The aim here is to develop further houses of quality slowly refining the level of detail until the design is specified at an implementable level.

Moving from one house to the next you carry over the corresponding targets and importance measures where the number of houses used in drill-down may vary – increasing with the level of complexity.

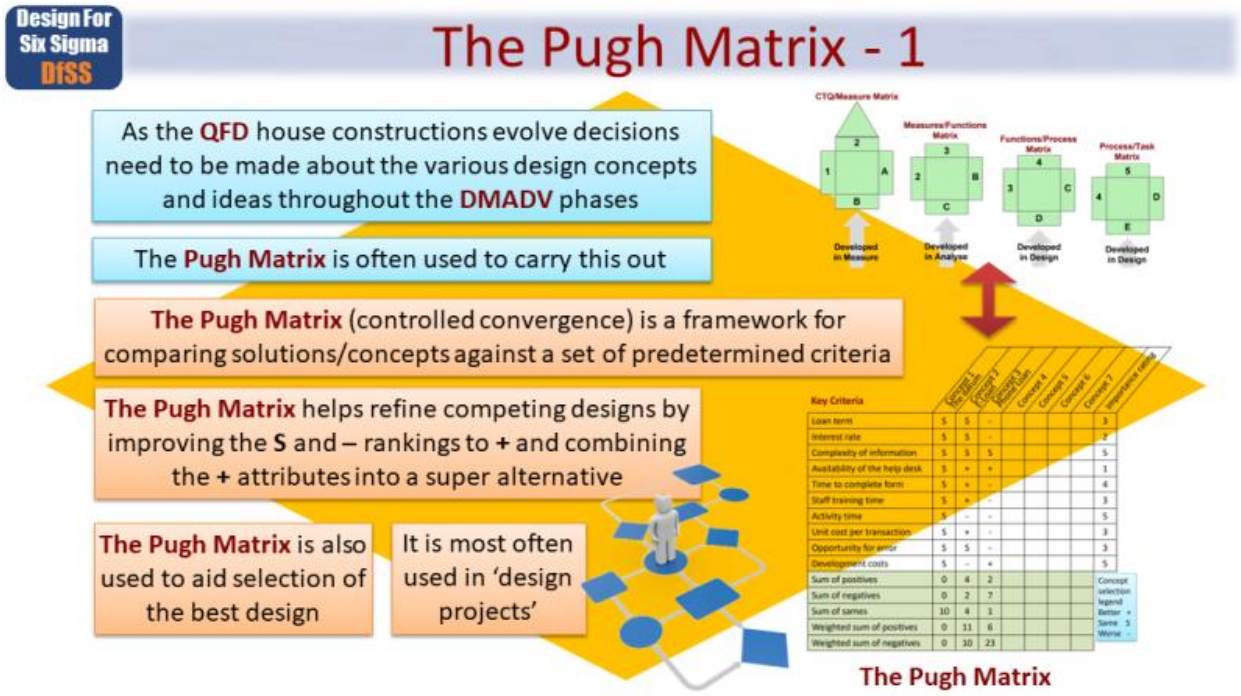
In the second House of Quality (developed in the analysis phase), the CTQ measures and the targets/importance ratings are taken from the first House of Quality.

You find the correlations to enter in the cells by asking "if I design this particular function correctly, what impact does it have on my ability to meet the CTQ's measures/targets?"

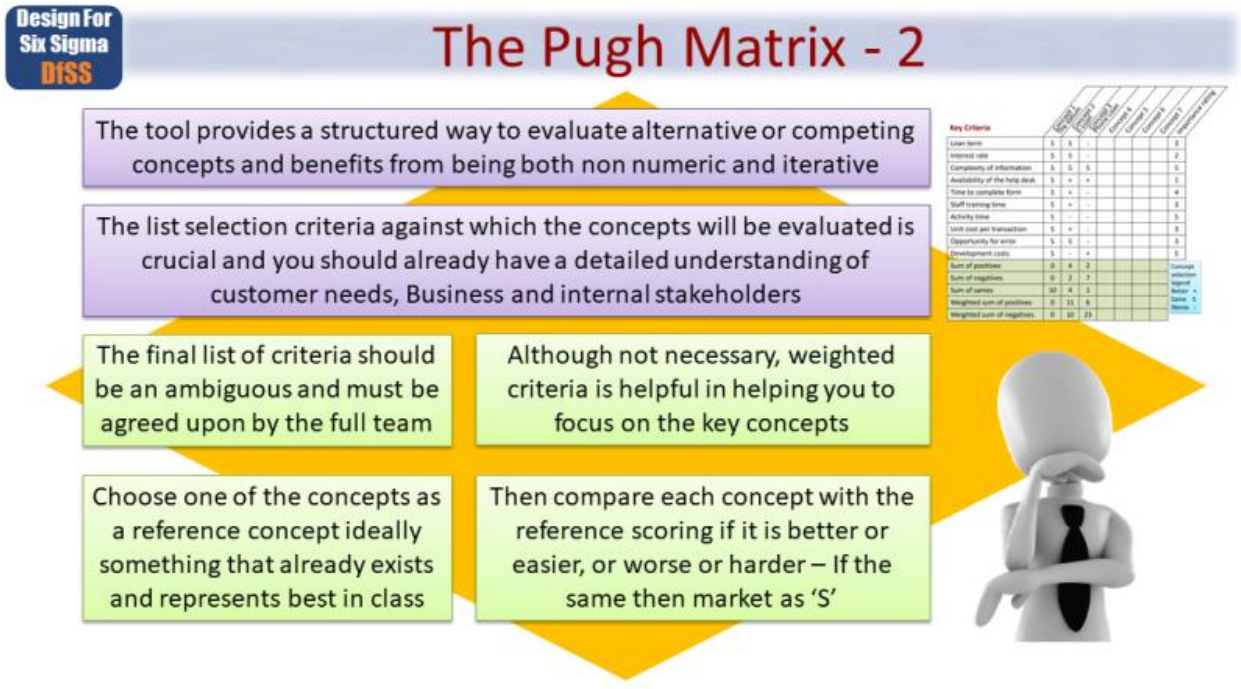
This helps identify where the design effort must be concentrated to satisfy the CTQs and thereby the customers



The Pugh Matrix



As the QFD house constructions evolve decisions need to be made about the various design concepts and ideas throughout the DMADV phases, and The Pugh Matrix is often used to carry this out.



The Pugh Matrix (controlled convergence) is a framework for comparing solutions/concepts against a set of predetermined criteria.

The Pugh Matrix helps refine competing designs by improving the S and – rankings to + and combining the + attributes into a super alternative

The Pugh Matrix is also used to aid the selection of the best design. It is most often used in 'design projects'. The tool provides a structured way to evaluate alternative or competing concepts and benefits from being both non-numeric and iterative.

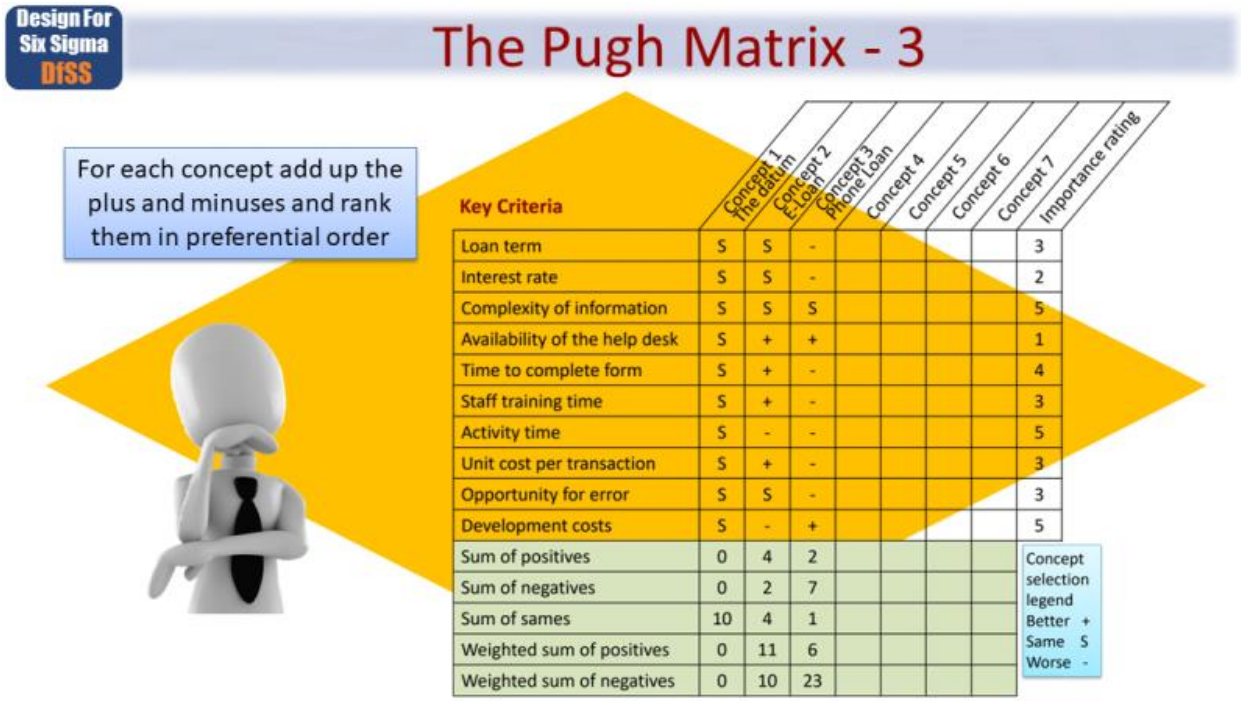
The list selection criteria against which the concepts will be evaluated is crucial and you should already have a detailed understanding of customer needs, Business, and internal stakeholders.

The final list of criteria should be unambiguous and must be agreed upon by the full team.

Although not necessary, weighted criteria are helpful in helping you to focus on the key concepts.

Choose one of the concepts as a reference concept ideally something that already exists and represents best in class.

Then compare each concept with the reference scoring if it is better or easier, or worse or harder – If the same then market as 'S'

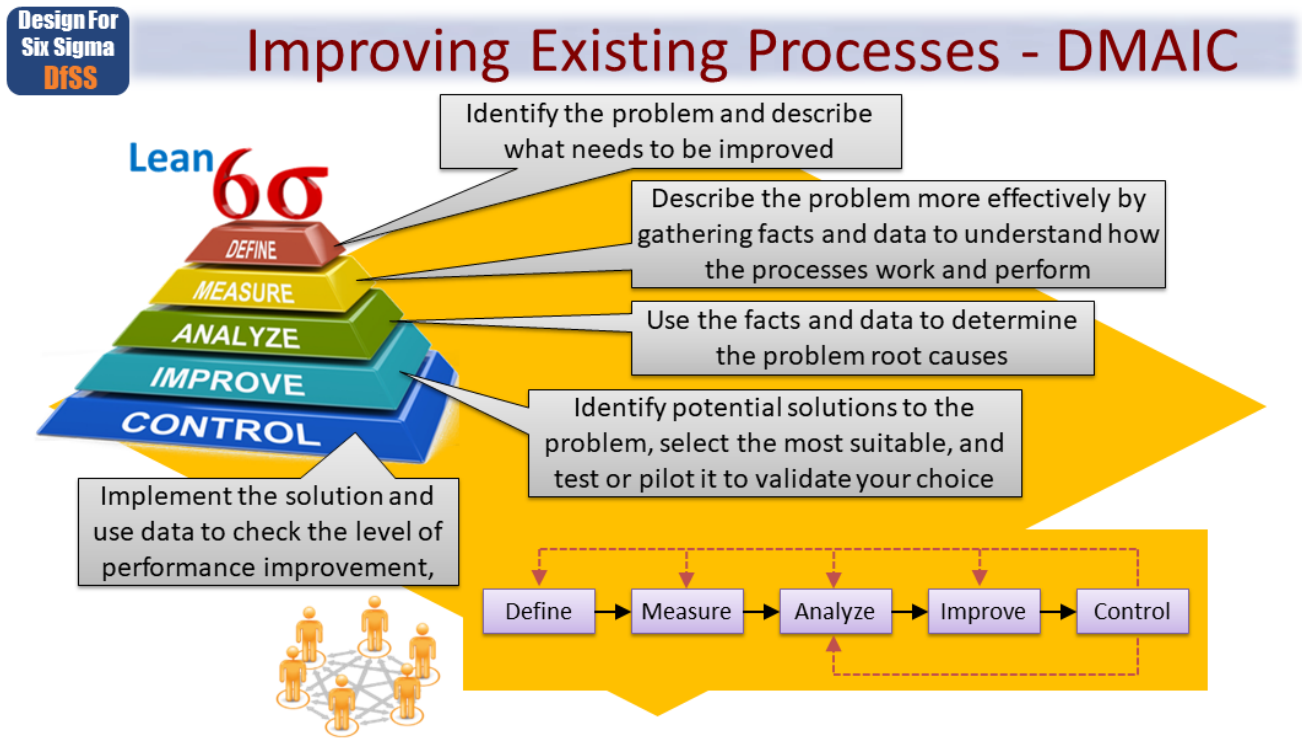


Key Criteria	Concept 1 The datum	Concept 2 E-Loan	Concept 3 Phone Loan	Concept 4	Concept 5	Concept 6	Concept 7	Importance rating
Loan term	S	S	-					3
Interest rate	S	S	-					2
Complexity of information	S	S	S					5
Availability of the help desk	S	+	+					1
Time to complete form	S	+	-					4
Staff training time	S	+	-					3
Activity time	S	-	-					5
Unit cost per transaction	S	+	-					3
Opportunity for error	S	S	-					3
Development costs	S	-	+					5
Sum of positives	0	4	2					
Sum of negatives	0	2	7					
Sum of sames	10	4	1					
Weighted sum of positives	0	11	6					
Weighted sum of negatives	0	10	23					

Concept selection legend
Better +
Same S
Worse -

For each concept add up the plus and minuses and rank them in preferential order


DESIGN FOR SIX SIGMA
MODULE ONE
DMAIC AND DMADV
Projex Academy
Dave Litten


Design For Six Sigma DfSS
Improving Existing Processes - DMAIC
Lean 6σ
DEFINE
MEASURE
ANALYZE
IMPROVE
CONTROL
Identify the problem and describe what needs to be improved
Describe the problem more effectively by gathering facts and data to understand how the processes work and perform
Use the facts and data to determine the problem root causes
Identify potential solutions to the problem, select the most suitable, and test or pilot it to validate your choice
Implement the solution and use data to check the level of performance improvement,
Define
Measure
Analyze
Improve
Control

Design For Six Sigma DfSS

Design for Six Sigma (DfSS) - 1

These modules are a companion to our Projex Academy **Lean Six Sigma Masterclass**

Lean Six Sigma used the **DMAIC** Method, whereas **DfSS** uses the **DMADV** Method – **D**efine, **M**easure, **A**nalyse, **D**esign and **V**erify



DMAIC is used to improve existing processes, but sometimes the process does not exist and you need to create one, perhaps for new services or products

It may be that your current process is so poor that scrapping it and starting again makes more sense

You can design products and services, and the processes that support them, that will delight your customers (with high customer involvement too) from the very start

DMADV Will help introduce new products and services quickly and to a consistently high standard

Design For Six Sigma DfSS

Design for Six Sigma (DfSS) - 2

When redesigning a process we focus on the customer, when designing a new service or product there **may not be a customer yet** so we focus on the demands of the (potential) marketplace



Where the customer is involved, this means both end user customers, internal business stakeholders, and users



Customer requirements and the resulting **CTQ**' s are established early on and the **DMADV** framework ensures that these requirements are satisfied in the final product, service or process

As with **DMAIC**, we manage by facts and not speculation to ensure that new designs reflect customer **CTQ**'s and provide real value to the customers

Design For Six Sigma DfSS

Design for Six Sigma (DfSS) - 3

DMADV projects are more resource hungry than **DMAIC** projects in terms of people, IT involvement and cost

Despite these higher costs and risks, **DMADV** projects bring higher rewards



In large organisations using **Lean Six Sigma**, 20 **DMAIC** projects will likely be carried out for every one **DMADV** project

There are likely to be many lean projects, and moderate number of **DMAIC** projects, and a few **DfSS** projects as the organisation gradually reduces rework and waste, improving process flow and reducing cycle times



DfSS often concentrates on the 'delighter' curve in the **Kano model**

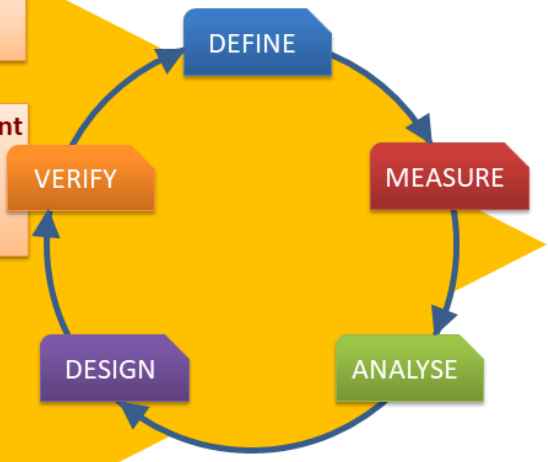
Design For Six Sigma DfSS

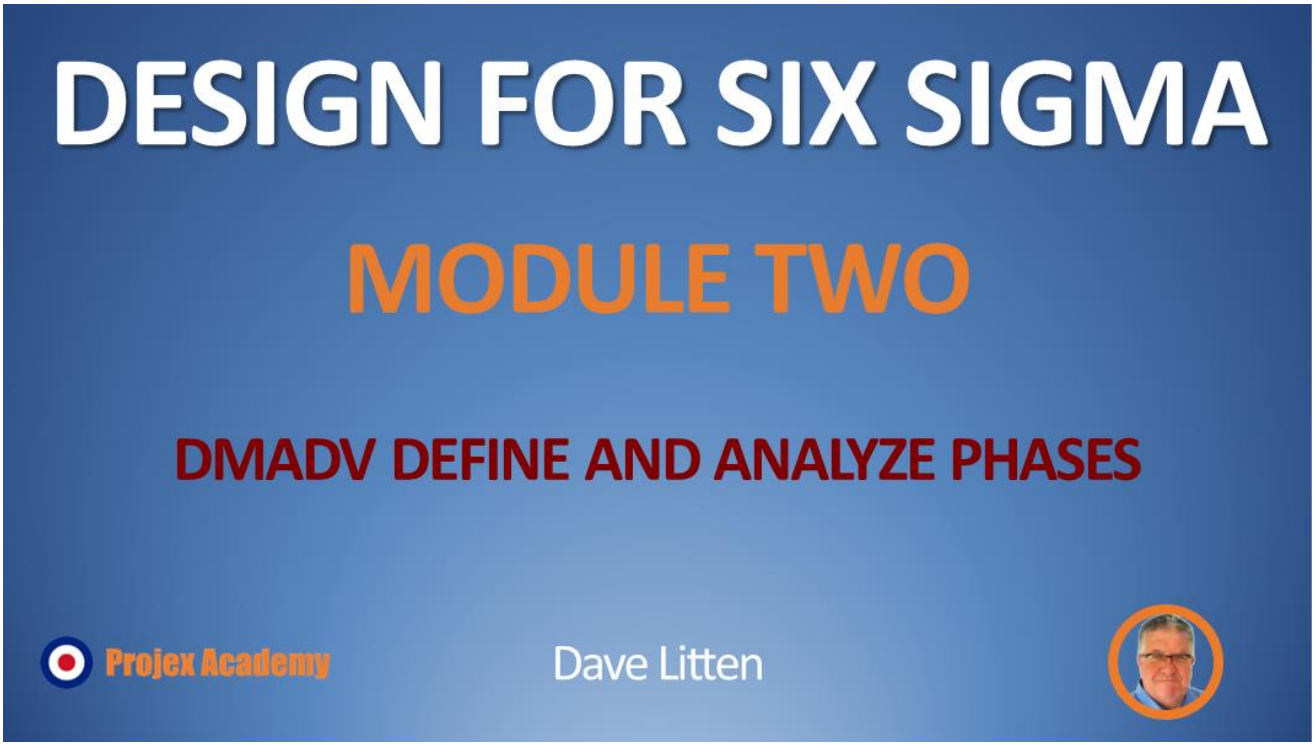
Design for Six Sigma (DfSS) - 4

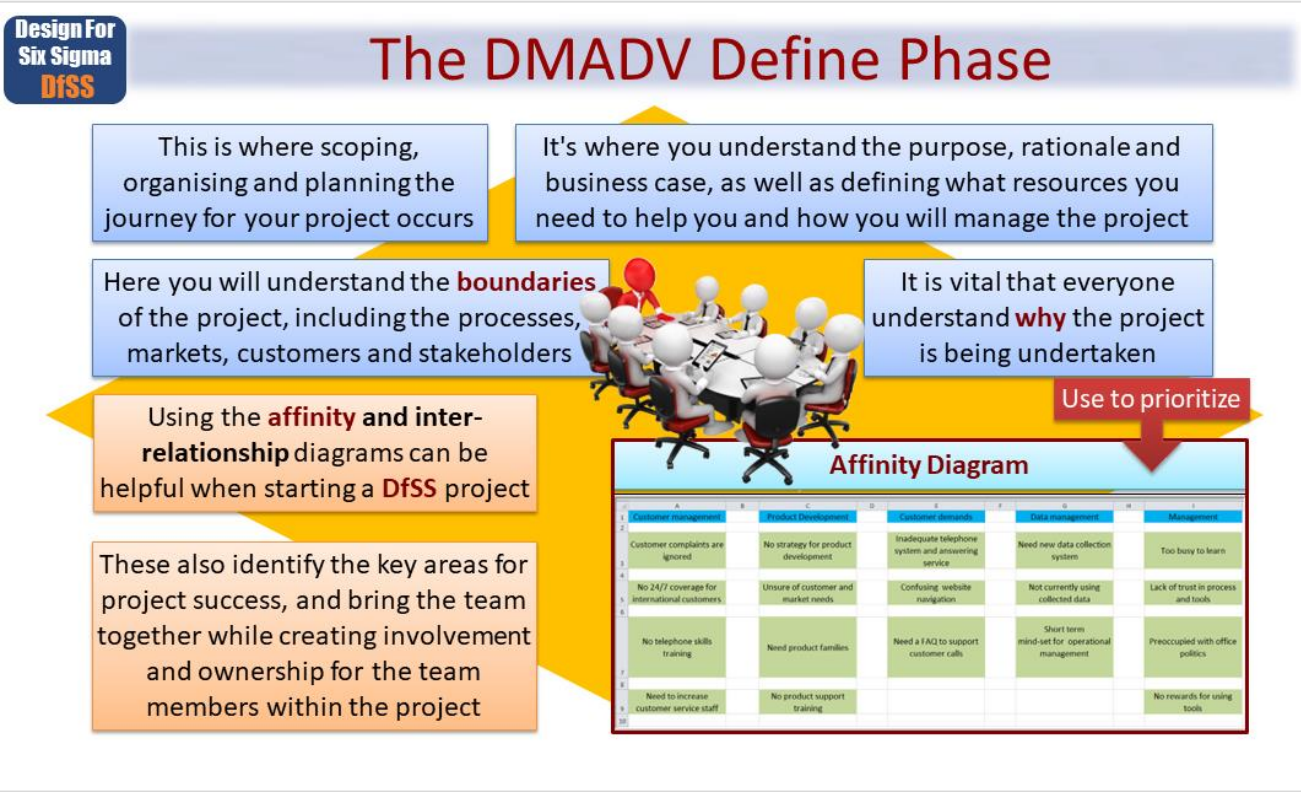
DMADV Projects are normally used to introduce radical change within an organisation

It is important that you have a **change management framework** in place to address and manage the various people issues that are so important for the successful completion of the project






DESIGN FOR SIX SIGMA
MODULE TWO
DMADV DEFINE AND ANALYZE PHASES
Projex Academy
Dave Litten


Design For Six Sigma DfSS
The DMADV Define Phase
This is where scoping, organising and planning the journey for your project occurs
It's where you understand the purpose, rationale and business case, as well as defining what resources you need to help you and how you will manage the project
Here you will understand the boundaries of the project, including the processes, markets, customers and stakeholders
It is vital that everyone understand why the project is being undertaken
Using the affinity and inter-relationship diagrams can be helpful when starting a DfSS project
Use to prioritize
Affinity Diagram
These also identify the key areas for project success, and bring the team together while creating involvement and ownership for the team members within the project

Design For Six Sigma DfSS

The DMADV Measure Phase

The measure phase provides the framework around which the design can be built and is used to make design decisions needed in further phases

Here, the focus is on defining and understanding customer needs, and the different customer segments

DfSS projects seek to optimise the design of products or processes across multiple customer requirements, so a detailed understanding of these is essential

Project needs are translated into measurable characteristics (**CTQ**'s) that provides the **requirements** for the product, define the measures, and set targets and **CTQ** specification limits service or process

For new products or services you must make sure the design can be produced with existing processes, or designing new processes to accommodate such new designs



Process capability is considered in the measure phase rather than after the design is complete(as in **DMAIC**)

Design For Six Sigma DfSS

The DMADV Analyse Phase - 1

Here is where the **functional specification** and **high-level designs** are developed, going on to create and test the detailed design

The analysis phase moves from the 'what the customer needs' to the 'how we might achieve it'

Mapping the **CTQ**'s onto internal functions and looking at **alternative** design concepts

"Some people think design means how it looks, but if you dig deeper, it's really how it works"
- Steve Jobs

"Design means how something works, not how it looks – the design should evolve from the function"
- James Dyson



For a **service**, analysis identifies the key functions; for a more tangible **product**, analysis identifies its key part characteristics

The sub-system characteristics are developed next, followed by the components (parts) of the sub-system

The DMADV Analysis Phase - 2

Functions are what the product, service or process has to do to meet the **CTQ**'s identified and specified in the design process



For a service, functions are key high-level processes to be considered

You will carry out an analysis of the functions to understand their performance capability to ensure they are fit for purpose

Analysis analyses and selects the best design concept and starts to add more detail to it

The **DfSS** project **emphasis** is on alternative design concepts, and the generation, analysis and assessment of a high-level design

Each design element is considered in turn with high-level design requirements for each



Consideration needs to be given to how each component fits and interacts with each other

The DMADV Analysis Phase - 3

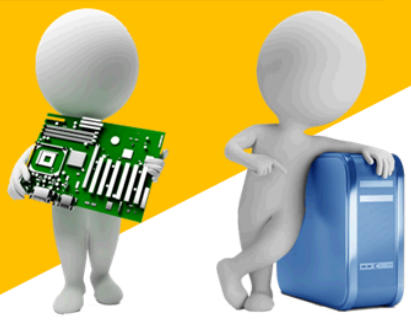
The analysis phase usually creates several high-level designs, assessing their suitability's and selecting the best fit

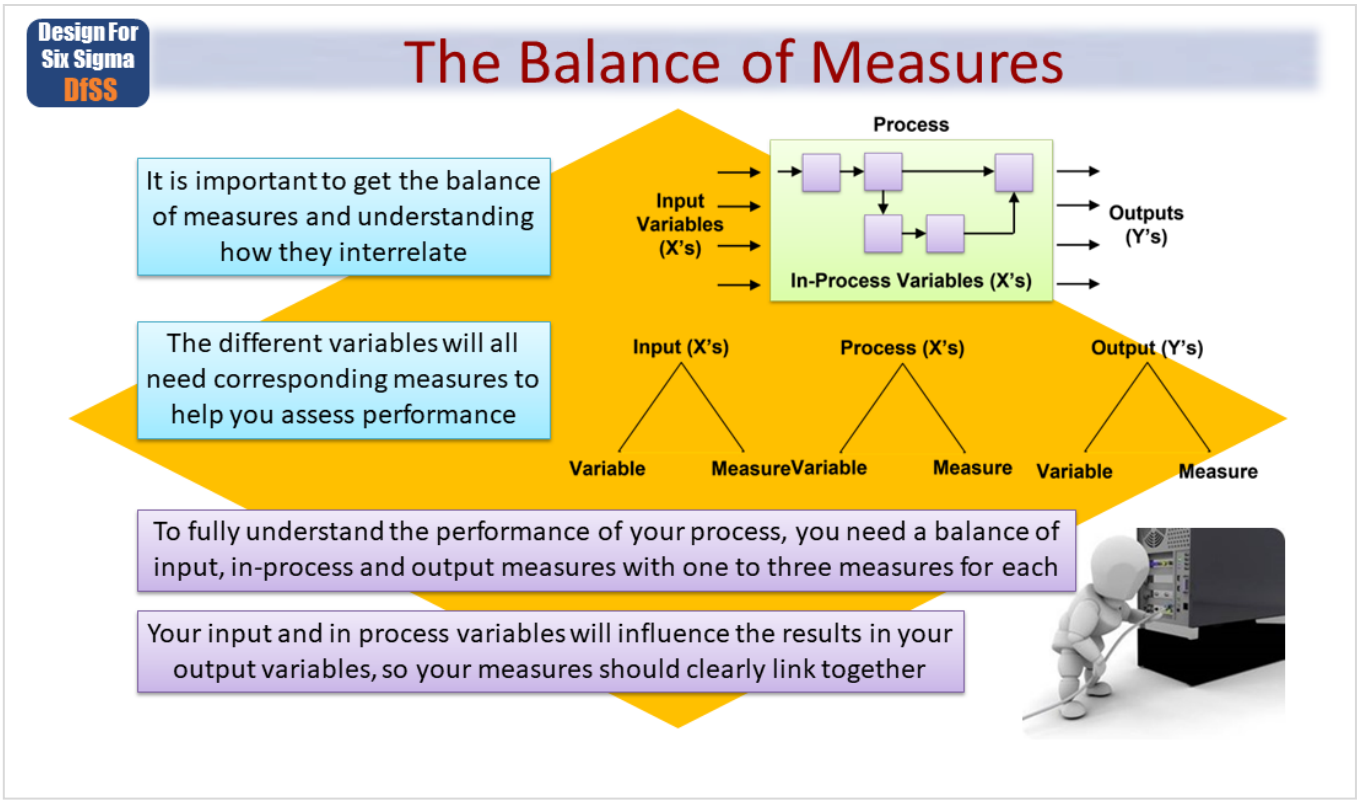
You need to assess performance and develop **design scorecards** to help analyse how capable the design is to deliver the **CTQ**'s

Such assessments may be carried out through simulations, field tests, or pilots involving the customer to capture their feedback

The Design Scorecard method deploys the requirements into the design and predicts the capability of the new design

The Design Scorecard captures the critical performance measures at each level and visibly track the measured performance as the design evolves




Design For Six Sigma DfSS
The Balance of Measures
It is important to get the balance of measures and understanding how they interrelate
Process
Input Variables (X's)
Outputs (Y's)
In-Process Variables (X's)
The different variables will all need corresponding measures to help you assess performance
Input (X's)
Process (X's)
Output (Y's)
Variable
Measure
Variable
Measure
Variable
Measure
To fully understand the performance of your process, you need a balance of input, in-process and output measures with one to three measures for each
Your input and in process variables will influence the results in your output variables, so your measures should clearly link together


DESIGN FOR SIX SIGMA
MODULE THREE
DMADV DESIGN AND VERIFY PHASES
Projex Academy
Dave Litten

Design For Six Sigma DfSS

Failure Mode Effects Analysis (FMEA)

Based on the outputs of the review, the high level design requirements can be finalised and a thorough risk assessment undertaking using **FMEA**

For each of these **potential events (failure modes)** you assign a value, usually on a **scale of 1 to 10**, to reflect the **risk**

Rating	Effect Severity	Probability	Current detectability
1	None	Remote	Immediately detected
2	Very minor effect	Very low	Found easily
3	Minor	Low	Usually found
4	Low to moderate	Low to moderate	Probably found
5	Moderate	Moderate	May be found
6	Moderate to high	Moderate to high	Less than 50%
7	High	High	Unlikely detected
8	Very high	Very high	Very unlikely detected
9	Hazardous	Extremely high	Extremely unlikely detected
10	Disastrous	Almost certain	Almost impossible to detect



A failure mode is a mechanism by which the **system** fails, or the **process** fails

A failure mode usually impacts the customer or business

Design For Six Sigma DfSS

The DMADV Design Phase

Developing the Design

The design phase starts by developing the 'how' thinking in more detail adding this to the various elements of the high level design

The emphasis is on developing designs that will satisfy the **CTQ** requirements of the process outputs

The lowest level specification limits, control points and measures are determined to form the basis of the control plan that must be in place following implementation

The design is specified at a detailed enough level to develop a **pilot** and test it - because before implementation, you need to pilot the design

Enough detail should now be available to test and evaluate the capability of the design by preparing an effective and realistic **pilot** in this design phase



Design For Six Sigma DfSS

The DMADV Verify Phase

Verifying the design works

The design is **piloted** and assessed in the verify phase , and apart if any adjustments follow the pilot, implementation and deployment

The final step in the cycle is to assess the **achievements** made and **lessons learned**

The results are **verified** against the original **CTQ**'s, specifications and targets

Once the solution has been standardised and transferred to operations and process management, the project is closed

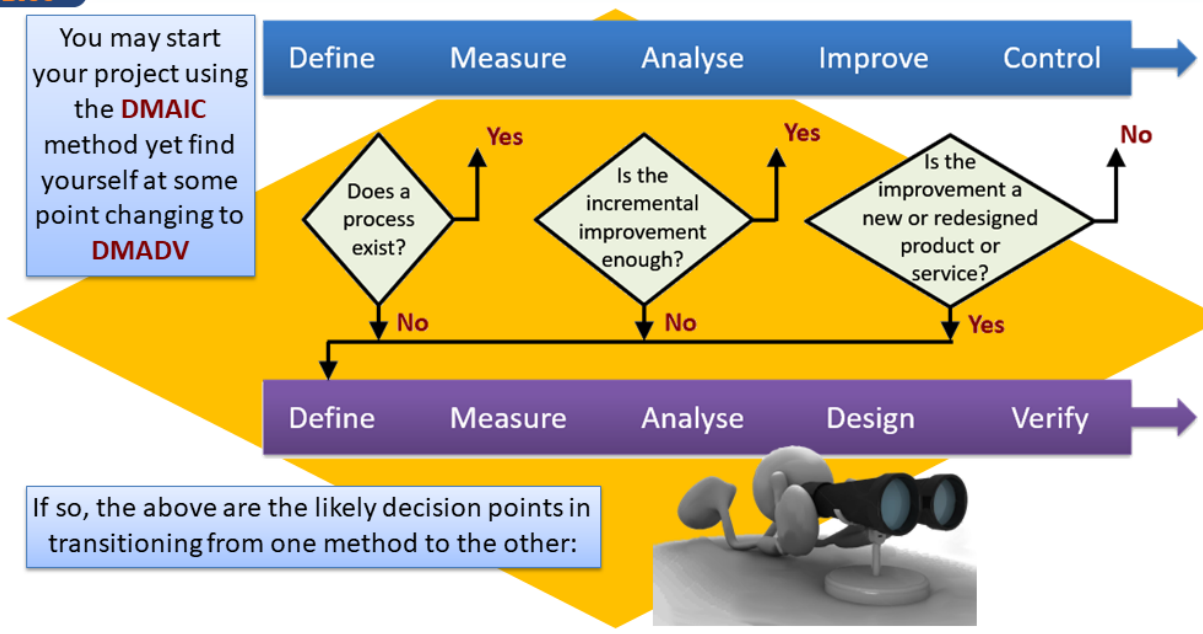
During the handover to the process owner or operational manager, you must work closely with your team to ensure a well planned and well documented transition



Design For Six Sigma DfSS

Choosing between DMAIC and DMADV

You may start your project using the **DMAIC** method yet find yourself at some point changing to **DMADV**



If so, the above are the likely decision points in transitioning from one method to the other:

Design For Six Sigma DfSS

Quality Function Deployment (QFD)

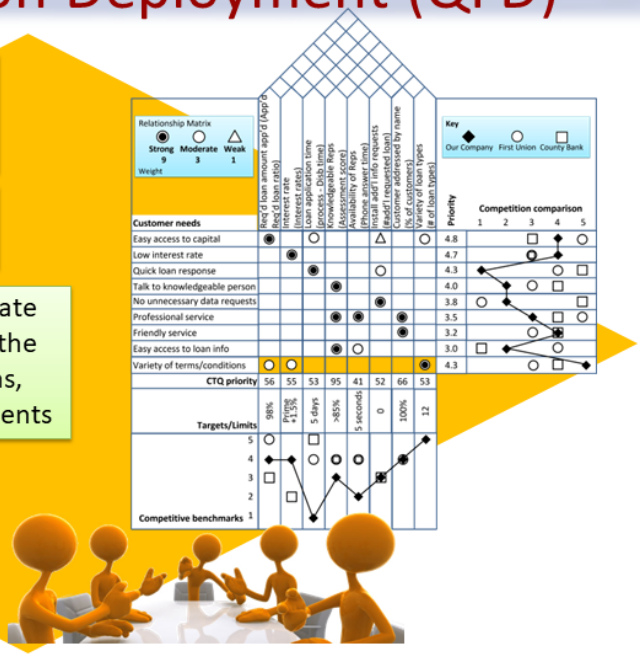
QFD is also known as the **House of Quality**

Customer research is used to determine the **voice of the customer**

Competition research helps us hear the **voice of the market**

Quality Function Deployment helps translate both voices into **high-level requirements** (the **CTQ**'s)and to place measurable definitions, specifications and targets on such requirements

In the analyse and design phases, **QFD** is further used to develop specifications for the lower-level details of the designed product, process or service so that high level customer **CTQ**'s can be satisfied



DESIGN FOR SIX SIGMA

MODULE FOUR

THE HOUSE OF QUALITY (QFD)
PART ONE

Projex Academy

Dave Litten

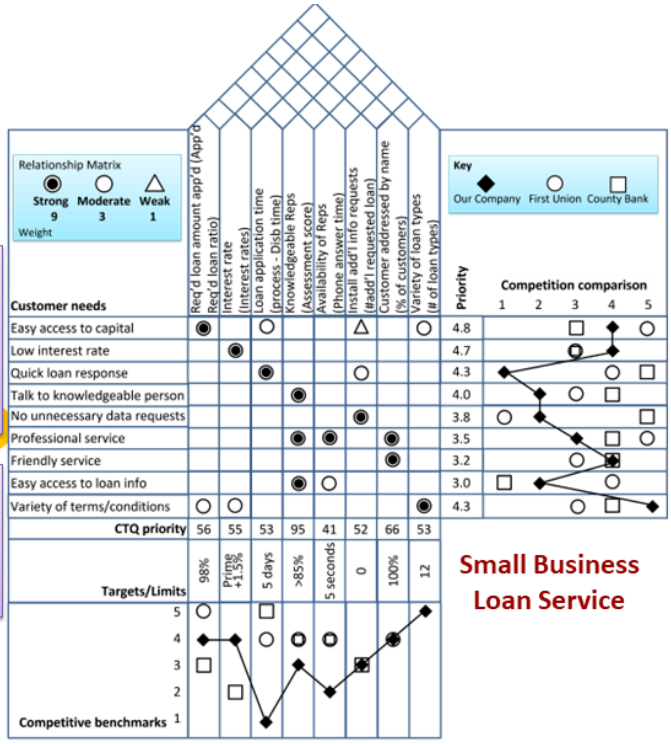


Design For Six Sigma DfSS

The House of Quality

QFD Is a graphical representation of the logic flow, from identifying **customer requirements** to the detailed development of actions to ensure those requirements are met

A series of **interconnected matrices** are developed, moving from the requirements, through to design, implementation and deployment



Small Business Loan Service

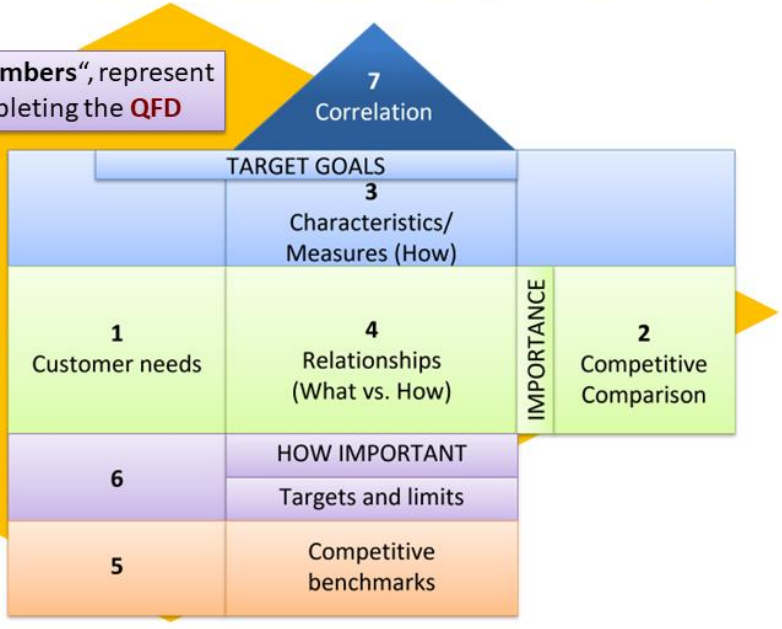
Design For Six Sigma DfSS

The House of Quality

The House of Quality "**room numbers**", represent the **logic flow order** for completing the **QFD**

I will now take you through each "**room**" in more detail …





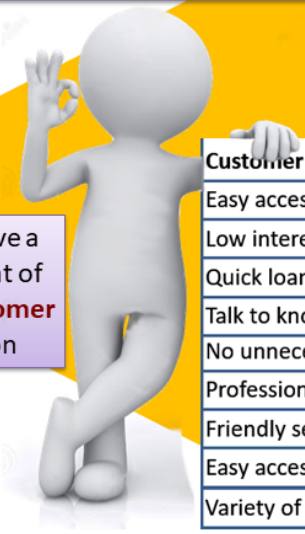
QFD – Customer Needs

The first thing you need to do is to **identify and segment** your customers, build a **data collection plan**, and conduct your customer research

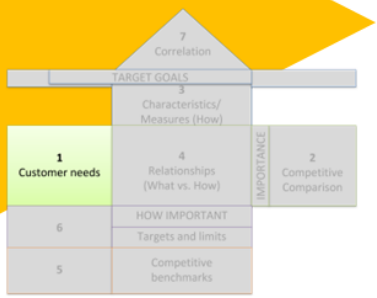
ROOM 1

Here you are focusing on organising the information that you have collected and then interpreting and translating that information into a set of **CTQ statements**

You now have a good amount of **voice of customer** information



Customer needs
Easy access to capital
Low interest rate
Quick loan response
Talk to knowledgeable person
No unnecessary data requests
Professional service
Friendly service
Easy access to loan info
Variety of terms/conditions



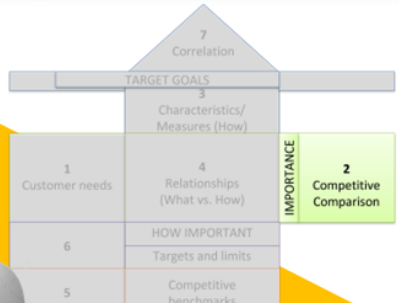
QFD – Competitive Information - 1

After collecting and completing the **CTQ**'s, their **relative importance** is established where the **QFD** approach initiates a **trade-off analysis**

Here you will determine which **requirements** are the **most important** so that when you enter the design phase you must understand the **priorities** from the customers viewpoint

The customers should be asked to **rank you against the competition** as part of organising and prioritising customer needs

This comparison can help your team determine the **strengths and weaknesses** of their current **product, service or process** with the resulting information being input to the target setting process for **CTQ**'s



ROOM 2



Design For Six Sigma DfSS

QFD – Competitive Information - 2

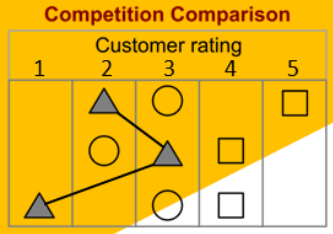
You will want to assign a **symbol** for your **own organisation** and one for each of your **competitors** who should be market leaders or the most distinguished organisations that you compete with

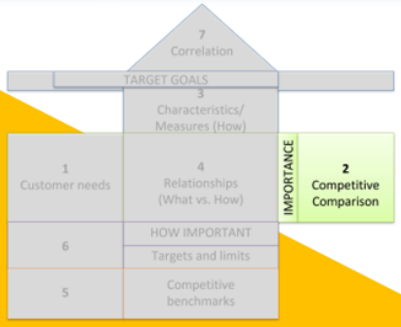
For each need in **Room 1**, ask your customer to assign a rating between 1 (lowest) and 5 (highest) for both your company and your competitors

The highest rating on the scale is reserved for how the **perfect service performs**

Clearly, 'Our Company' is **not** doing very well!







ROOM 2

Design For Six Sigma DfSS

QFD – Characteristics and Measures

Here, we start moving from the '**what**' to the '**how**' of the **customer requirements**

So far, we have only understood what the customer requires – **now** we need to understand the **characteristics and measures** needed to ensure the end design meets those requirements

For each customer attribute, you must determine what characteristics and measures will indicate **how well** you are meeting their needs

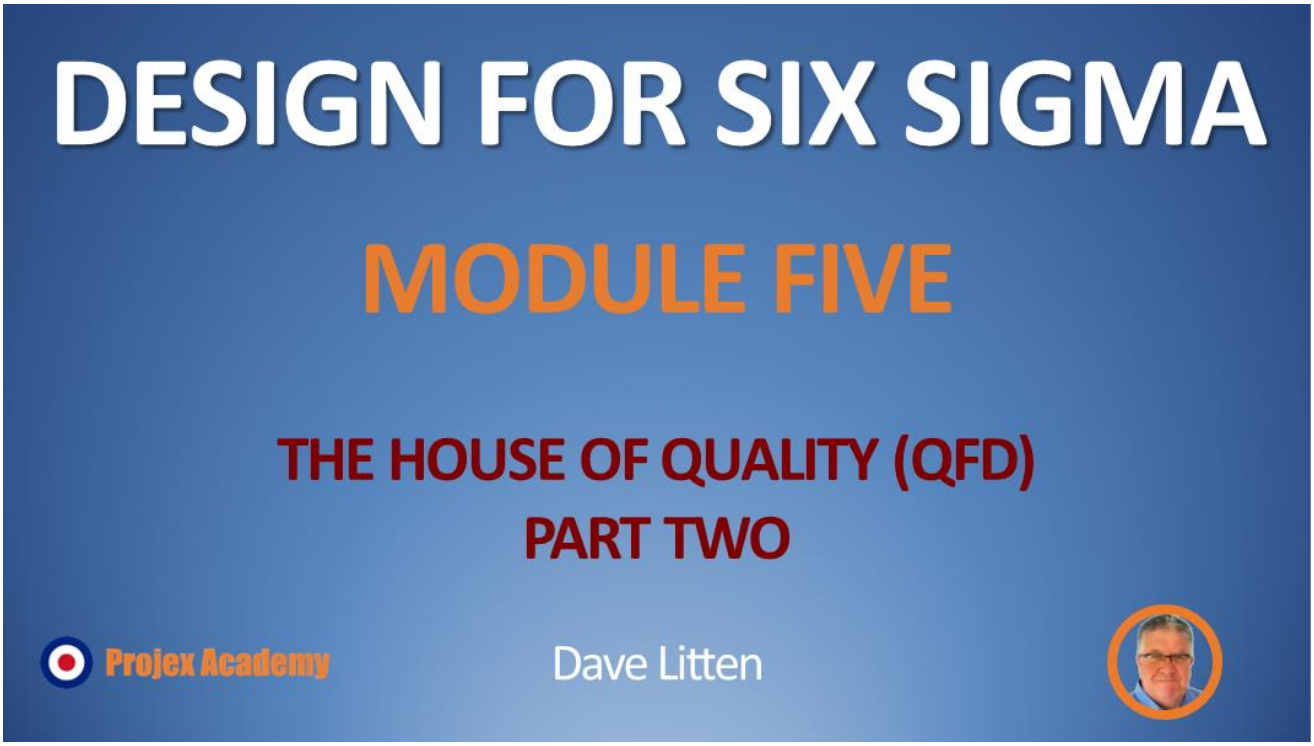
You will want to develop measures for which targets and specification limits can be established

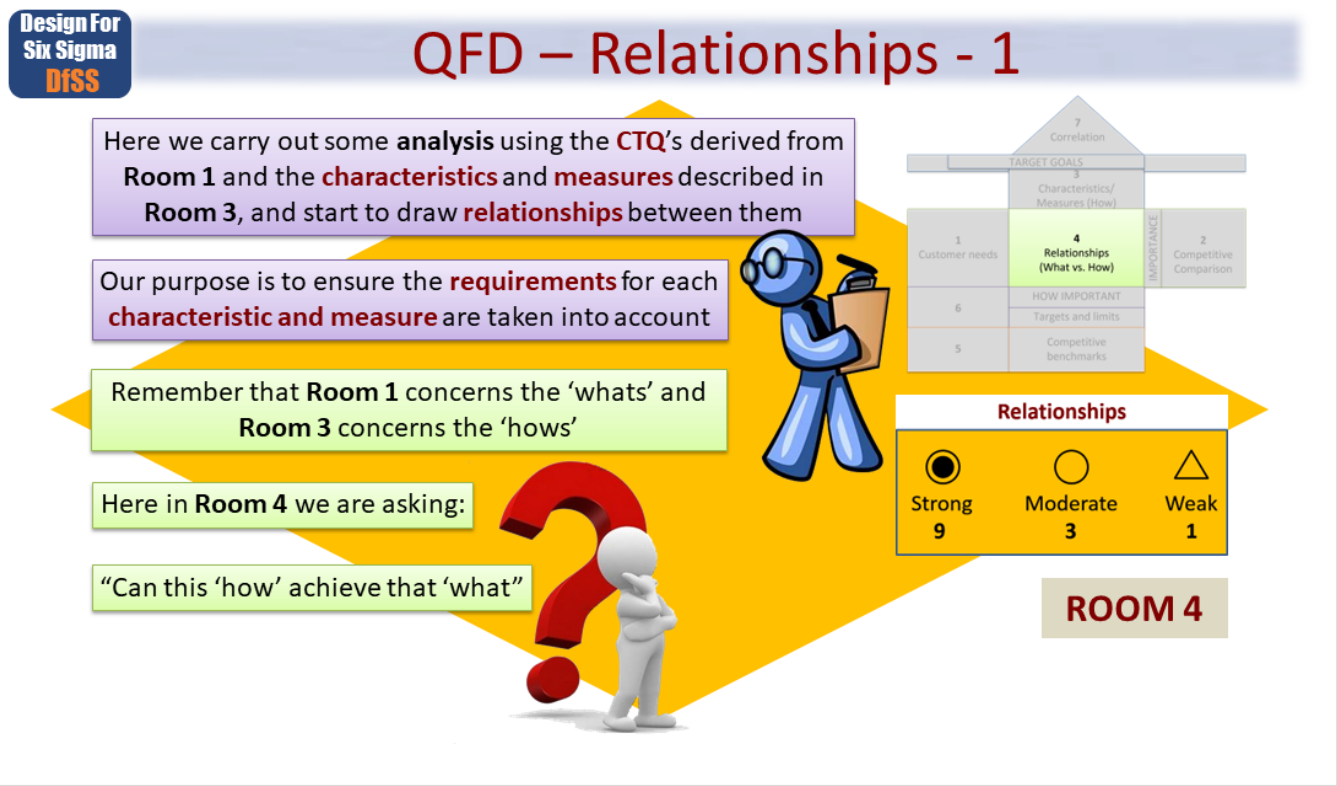
Do remember that measurements can produce two types of data – **continuous data**, such as time or temperature, and **discrete data**, such as accuracy



ROOM 3




DESIGN FOR SIX SIGMA
MODULE FIVE
THE HOUSE OF QUALITY (QFD)
PART TWO
Projex Academy
Dave Litten


Design For Six Sigma DfSS
QFD – Relationships - 1
Here we carry out some analysis using the CTQ's derived from Room 1 and the characteristics and measures described in Room 3, and start to draw relationships between them
Our purpose is to ensure the requirements for each characteristic and measure are taken into account
Remember that Room 1 concerns the 'whats' and Room 3 concerns the 'hows'
Here in Room 4 we are asking:
"Can this 'how' achieve that 'what"
Relationships
Strong 9
Moderate 3
Weak 1
ROOM 4

Design For Six Sigma DfSS

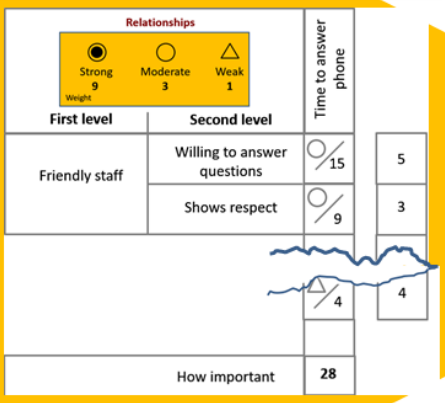
QFD – Relationships - 2

For each **relationship** (**Room 1**) and **characteristics** (**Room 3**), perform the following steps and complete the relationship matrix below:

Rate each **relationship** using a scale of Strong (9), Medium (3), Weak (1), or none (0)

Calculate the score for each cell by multiplying the **priority** for the customer need in **Room 2** by the (9, 3, 1, 0) value of each related cell

Once the relationships have been rated, add up the individual scores for each measure to determine their **importance**





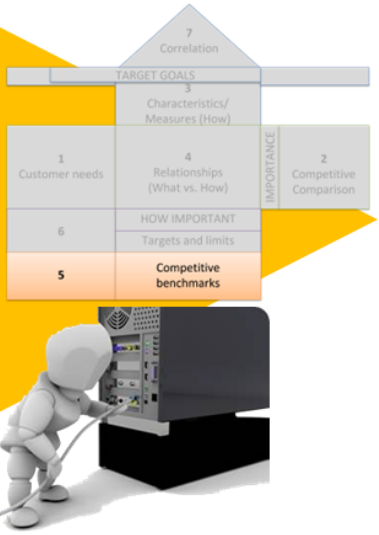
Design For Six Sigma DfSS

QFD – Competitive Benchmarking - 1

Benchmarking refers to looking both inside and outside of your own organisation to see how well others are doing at providing products and services **similar to yours** (performance benchmarking), and **how** 'best practice' organisations provide their products and services (process benchmarking)

Get competitive data for every key measure and analyse it using a 1-5 scale (1 = poor performance, 5 = best-in-class) with a separate row for each 1-5 grading





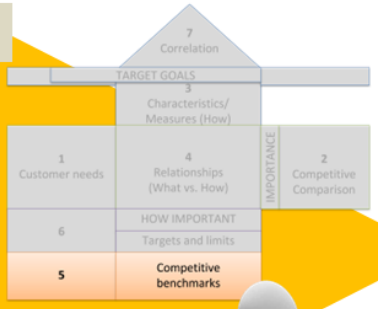
Design For Six Sigma DfSS

QFD – Competitive Benchmarking - 2

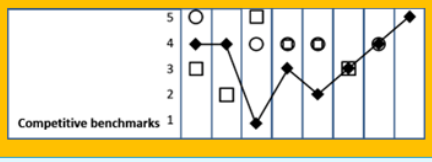
For each measure in **Room 3**, assign the symbols to the appropriate grading



ROOM 5







Qualitative benchmarking was done in **Room 2** where **customer perceptions** of your **qualitative performance** in relation to the **CTQ**'s were established

Quantitative benchmarking performance was done in relation to the **measures** established in **Room 3** – Here, we are looking at **actual performance** as opposed to perceptions about performance



Design For Six Sigma DfSS

QFD – Targets and Limits

Using the results from the **Room 5 benchmarking**, we now set the goals and targets against the measures and characteristics defined in **Room 3**

ROOM 6



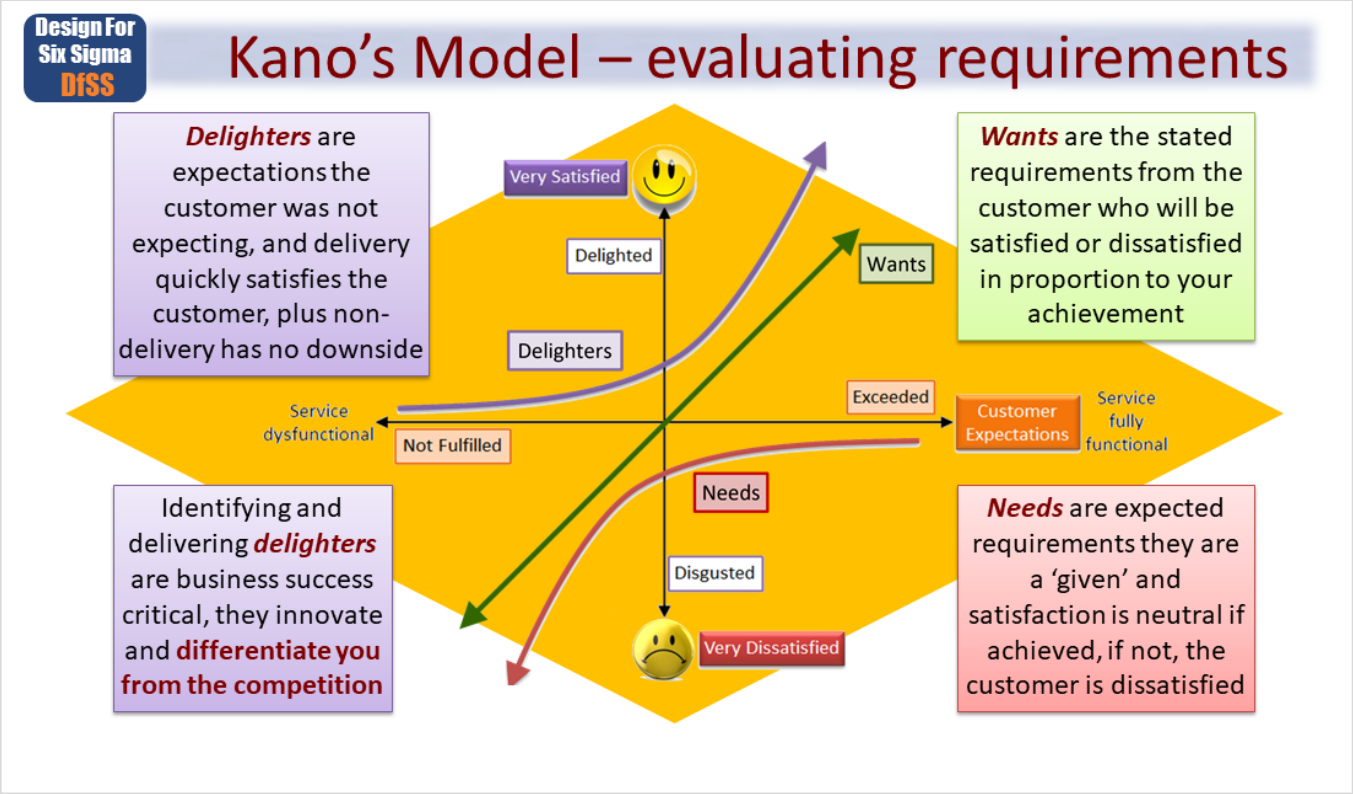


Targets/Limits	98%	Prime +1.5%	5 days	>85%	5 seconds	0	100%	12

Setting targets and specifications is a matter of **judgement** using business know-how and technical expertise along with the use of tools

Two tools often used are the analysis of benchmarking data and a good understanding of customer requirements using the **Kano model**




Design For Six Sigma DfSS
Kano's Model – evaluating requirements
Delighters are expectations the customer was not expecting, and delivery quickly satisfies the customer, plus non-delivery has no downside
Wants are the stated requirements from the customer who will be satisfied or dissatisfied in proportion to your achievement
Very Satisfied
Delighted
Delighters
Wants
Service dysfunctional
Not Fulfilled
Exceeded
Customer Expectations
Service fully functional
Needs
Disgusted
Very Dissatisfied
Identifying and delivering delighters are business success critical, they innovate and differentiate you from the competition
Needs are expected requirements they are a 'given' and satisfaction is neutral if achieved, if not, the customer is dissatisfied


DESIGN FOR SIX SIGMA
MODULE SIX
QFD AND THE PUGH MATRIX
Projex Academy
Dave Litten

Design For Six Sigma DfSS

QFD – Correlation- 1

The roof looks at the **impact** of each of the measures on the **CTQ**'s and how the **measures affect each other**

You first need to examine each measure and assess the likely impact of increasing, reducing or hitting the target for that measure on customer **CTQ**'s

Next, You examine the relationship between each pair of measures to understand the impact and effects of any relationship on the final design

Carry this out by assigning one of these four symbols to represent that relationship:

ROOM 7

++ strong positive
\+ positive
\- negative
-- strong negative

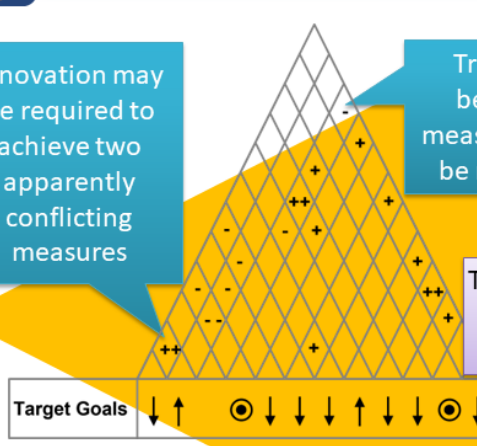


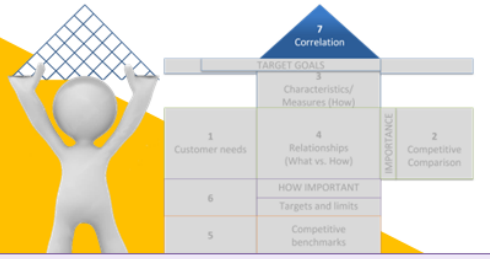
Design For Six Sigma DfSS

QFD – Correlation- 2

Innovation may be required to achieve two apparently conflicting measures

Trade-off between measures may be required

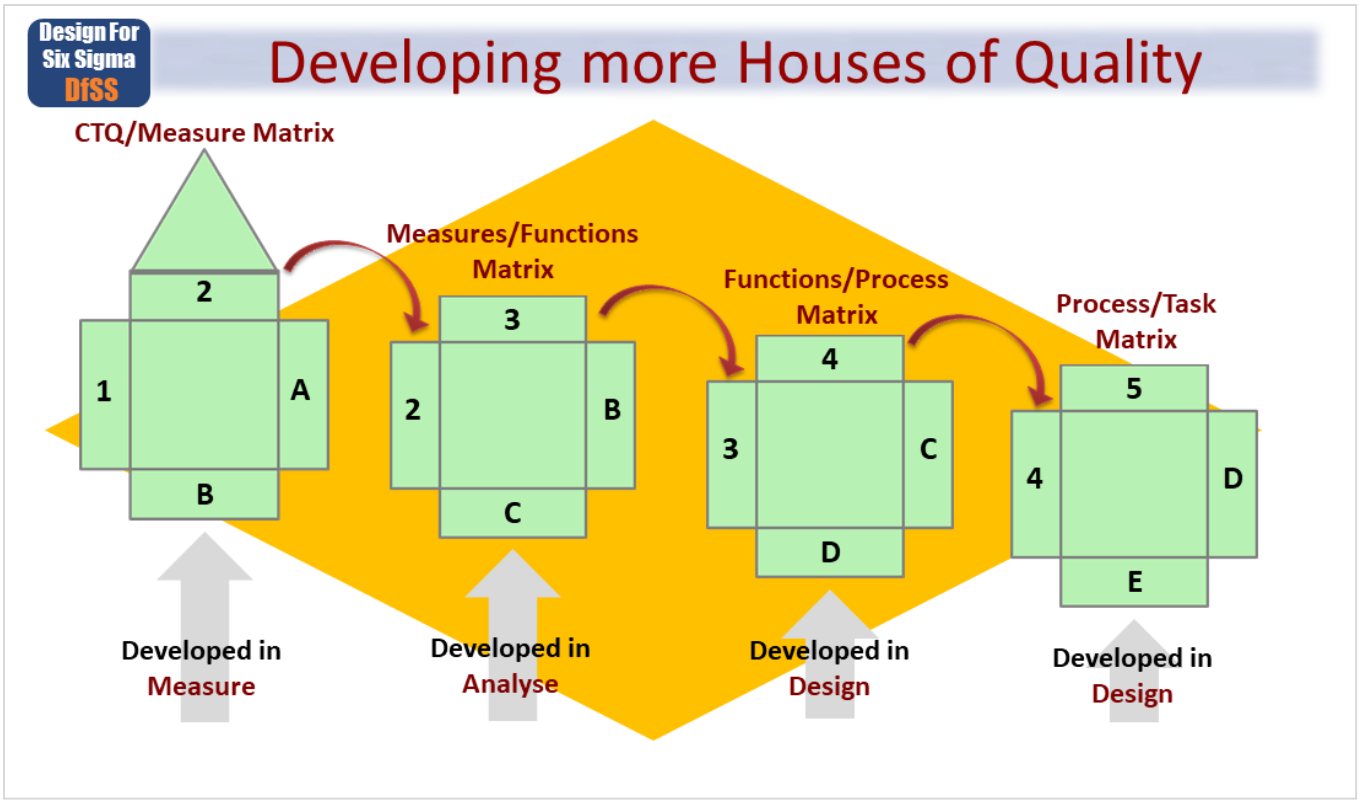


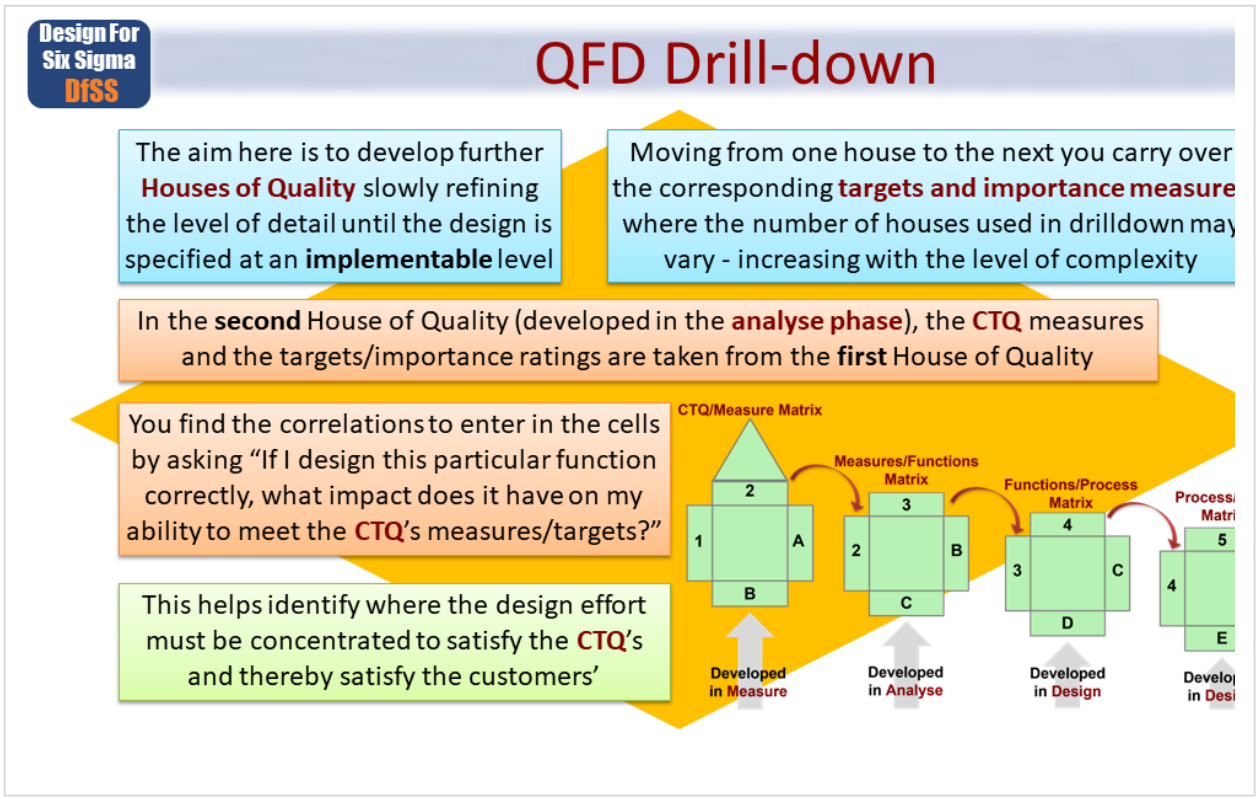


This shows **how** the various **characteristics and measu** impact the end design – the objective is to resolve th conflict in situations **before** you build the design

Good solutions and designs will not require trade-offs but satisfying negatively correlated measures requires time and forward thinking

Conflict resolution should focus on meeting the customer needs not yours and measures with strong positive correlations can become part of the overall **design strategy**


Design For Six Sigma DfSS
Developing more Houses of Quality
CTQ/Measure Matrix
Measures/Functions Matrix
Functions/Process Matrix
Process/Task Matrix
2
1
A
B
3
2
B
C
4
3
C
D
5
4
D
E
Developed in Measure
Developed in Analyse
Developed in Design
Developed in Design


Design For Six Sigma DfSS
QFD Drill-down
The aim here is to develop further Houses of Quality slowly refining the level of detail until the design is specified at an implementable level
Moving from one house to the next you carry over the corresponding targets and importance measure where the number of houses used in drilldown may vary - increasing with the level of complexity
In the second House of Quality (developed in the analyse phase), the CTQ measures and the targets/importance ratings are taken from the first House of Quality
You find the correlations to enter in the cells by asking "If I design this particular function correctly, what impact does it have on my ability to meet the CTQ's measures/targets?"
This helps identify where the design effort must be concentrated to satisfy the CTQ's and thereby satisfy the customers'
CTQ/Measure Matrix
Measures/Functions Matrix
Functions/Process Matrix
Developed in Measure
Developed in Analyse
Developed in Design

Design For Six Sigma DfSS

The Pugh Matrix - 1

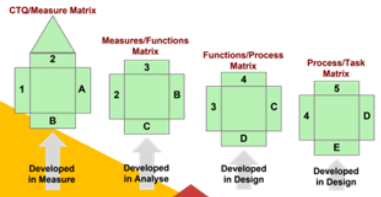
As the **QFD** house constructions evolve decisions need to be made about the various **design concepts and ideas** throughout the **DMADV** phases

The **Pugh Matrix** is often used to carry this out

The Pugh Matrix (controlled convergence) is a framework for comparing solutions/concepts against a set of predetermined criteria

The Pugh Matrix helps refine competing designs by improving the **S** and **–** rankings to **+** and combining the **+** attributes into a super alternative

The Pugh Matrix is also used to aid selection of the best design – and hence is most often used in 'design projects'





Key Criteria	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6	Concept 7	Importance rating
Loan term	S	S	-					3
Interest rate	S	S	-					2
Complexity of information	S	S	S					5
Availability of the help desk	S	+	+					1
Time to complete form	S	+	-					4
Staff training time	S	+	-					3
Activity time	S	-	-					5
Unit cost per transaction	S	+	-					3
Opportunity for error	S	S	-					3
Development costs	S	-	+					5
Sum of positives	0	4	2					
Sum of negatives	0	2	7					
Sum of sames	10	4	1					
Weighted sum of positives	0	11	6					
Weighted sum of negatives	0	10	23					

Concept selection legend: Better +, Same S, Worse -

The Pugh Matrix

Design For Six Sigma DfSS

The Pugh Matrix - 2

The tool provides a structured way to evaluate alternative or competing concepts and benefits from being both **non numeric and iterative**

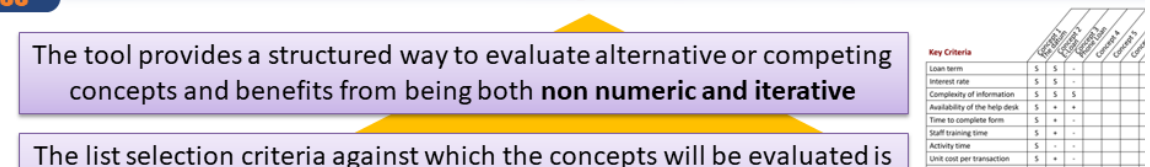
The list selection criteria against which the concepts will be evaluated is crucial and you should already have a detailed understanding of customer needs, Business and internal stakeholders

The final list of criteria should be **unambiguous** and must be agreed upon by the **full team**

Although not always necessary, **weighted criteria** is helpful in allowing you to focus on the key concepts

Choose one of the concepts as a **reference concept** (ideally something that already exists and represents best in class)

Then compare each concept with the reference scoring if it is better, or easier, or worse, or harder – If the same then mark it as an 'S'





Design For Six Sigma DfSS

The Pugh Matrix - 3

For each concept add up the plus and minuses and rank them in preferential order



Key Criteria	Concept 1 The datum	Concept 2 E-Loan	Concept 3 Phone Loan	Concept 4	Concept 5	Concept 6	Concept 7	Importance rating
Loan term	S	S	-					3
Interest rate	S	S	-					2
Complexity of information	S	S	S					5
Availability of the help desk	S	+	+					1
Time to complete form	S	+	-					4
Staff training time	S	+	-					3
Activity time	S	-	-					5
Unit cost per transaction	S	+	-					3
Opportunity for error	S	S	-					3
Development costs	S	-	+					5
Sum of positives	0	4	2					
Sum of negatives	0	2	7					
Sum of sames	10	4	1					
Weighted sum of positives	0	11	6					
Weighted sum of negatives	0	10	23					

Concept selection legend
Better +
Same S
Worse -

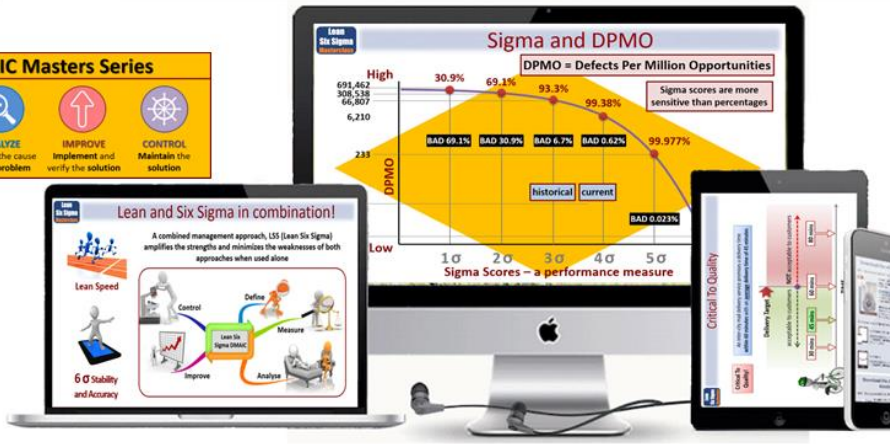
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Dave Litten