Lean Six Sigma Green Belt Certification Course

simplilearn

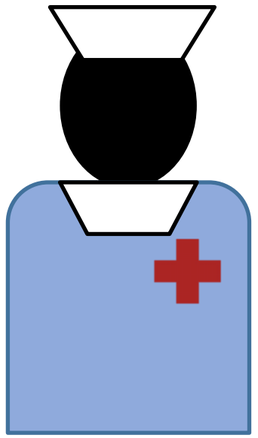
Design for Six Sigma (DFSS) Methodologies

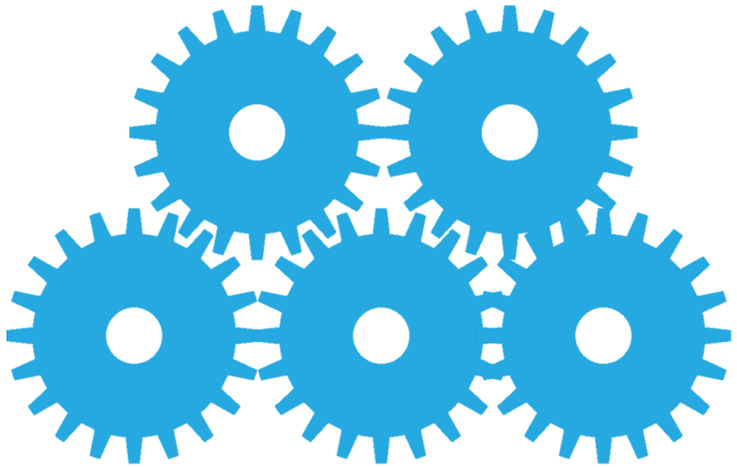
Learning Objectives

By the end of this lesson, you will be able to:

- Explain the roadmap for Design for Six Sigma (DFSS)
- List the DFSS Tools used to improve the products, services, or processes

Introduction





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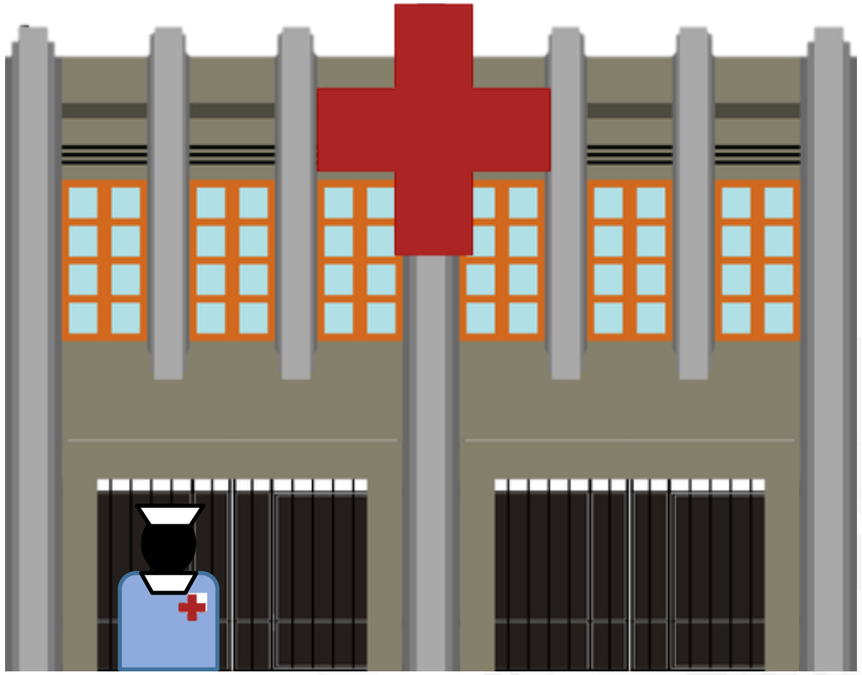
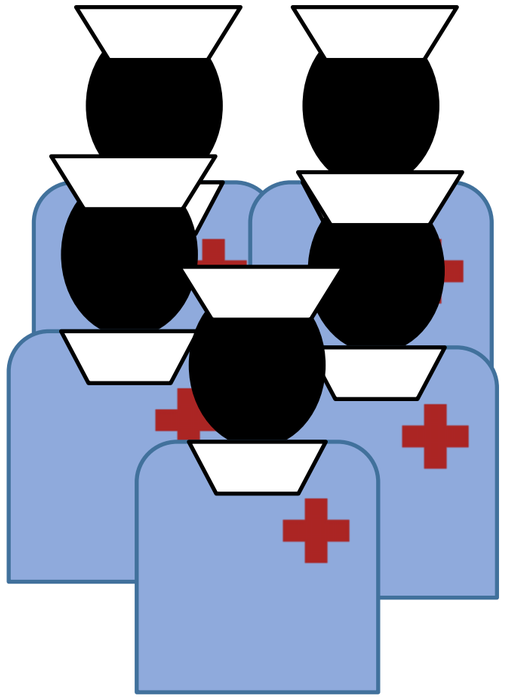
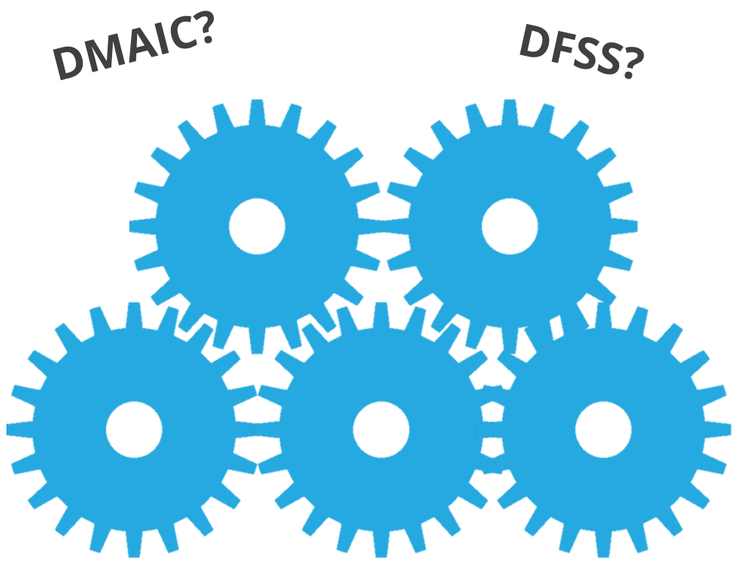


? What improvement methodology can be used?

Introduction





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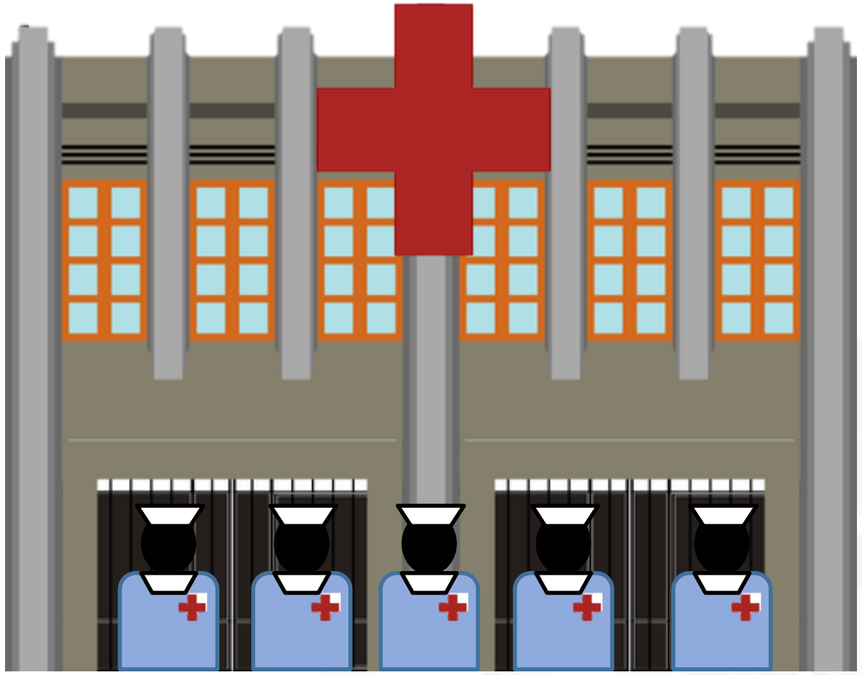
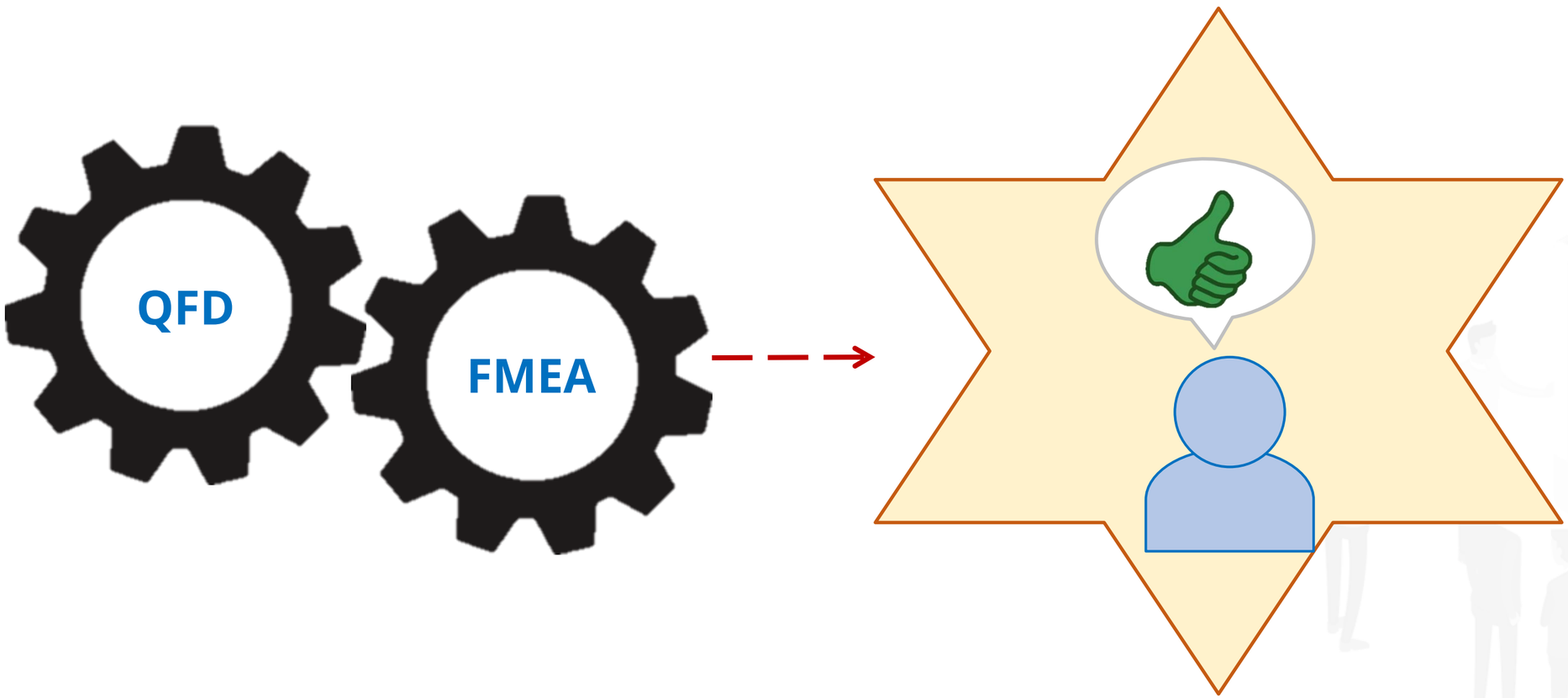


! Design For Six Sigma Methodologies (DFSS)

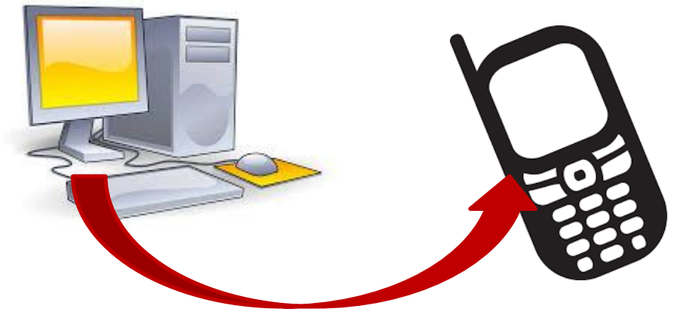
DIGITAL OPERATIONS

Roadmap for Design for Six Sigma (DFSS)

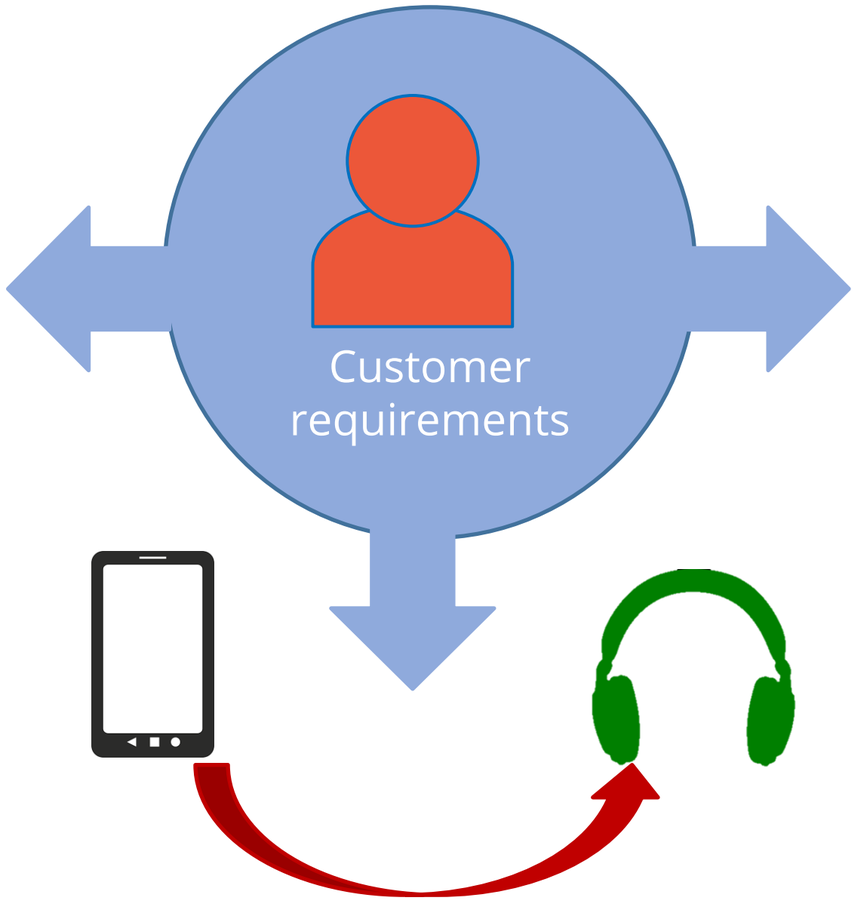
Concept of Design for Six Sigma (DFSS)

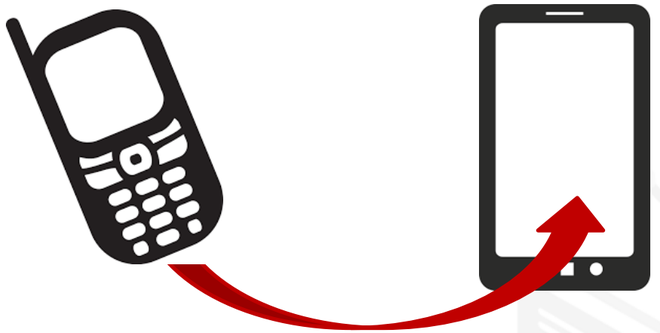


Impact of DFSS on an Organization



Entirely new product, service, or process

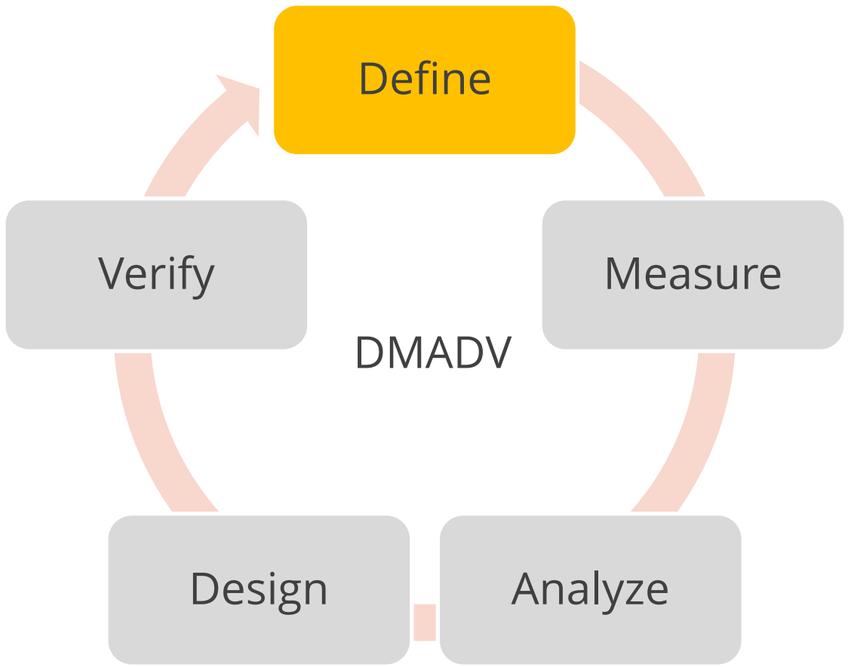


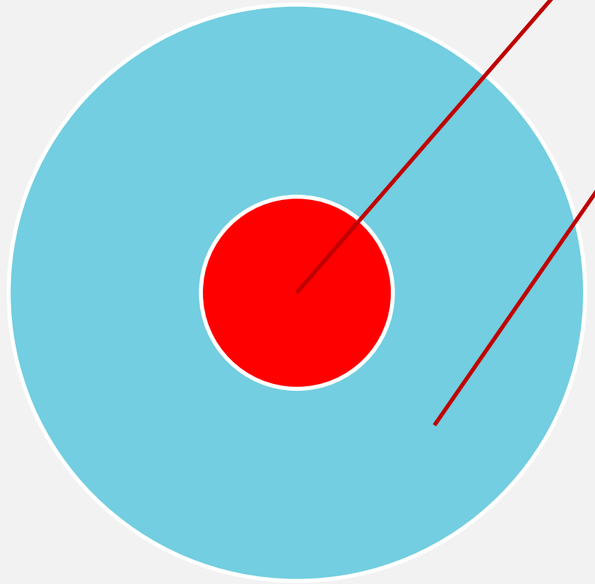


Completely improves existing product, service, or process

Add to existing product, service, or process lines

Types of DFSS Methodologies

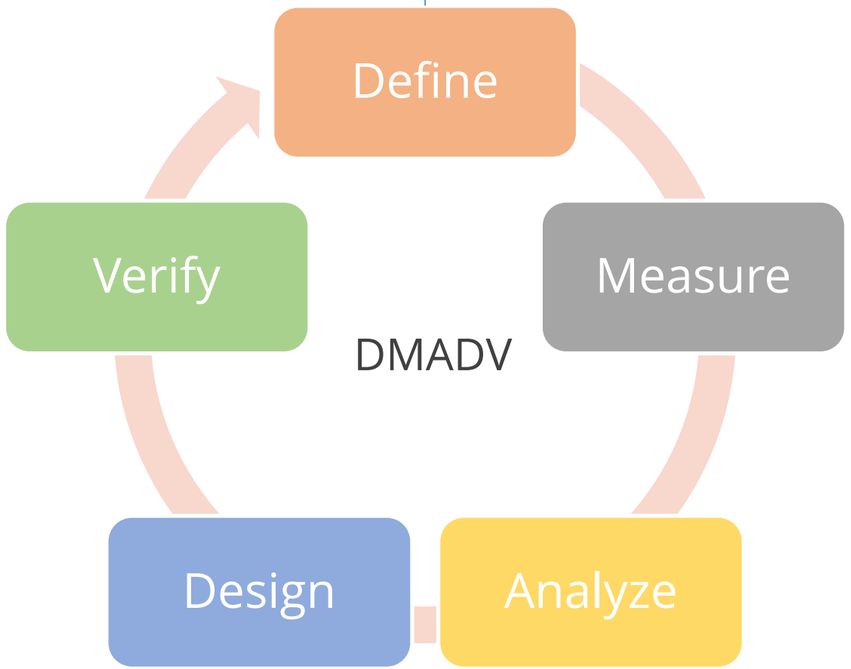




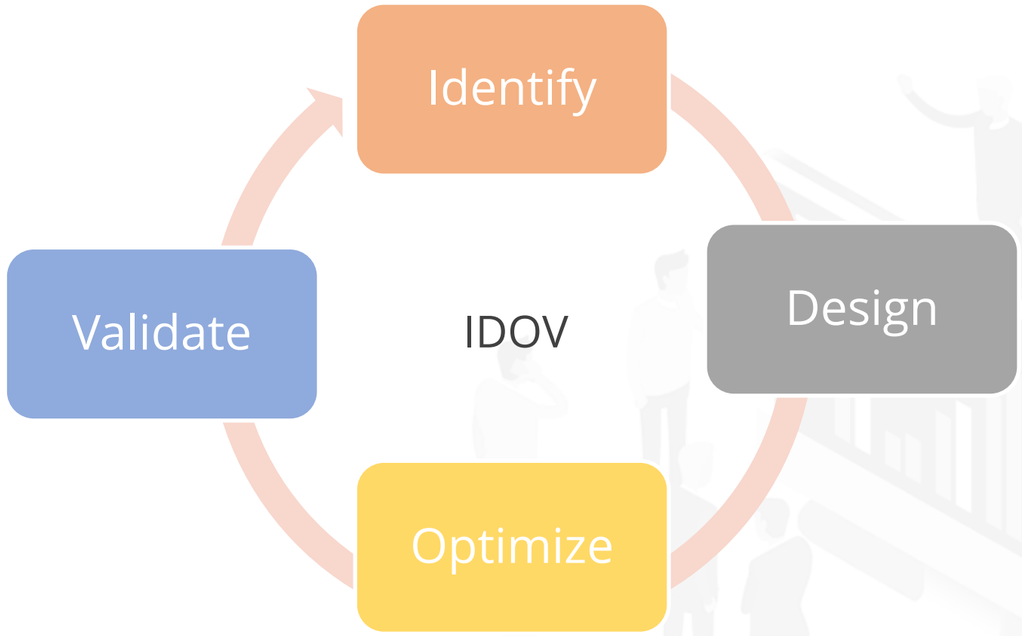
Define customer requirements and goals for the process, product, and service.

DMADV and IDOV

6σ Methodologies

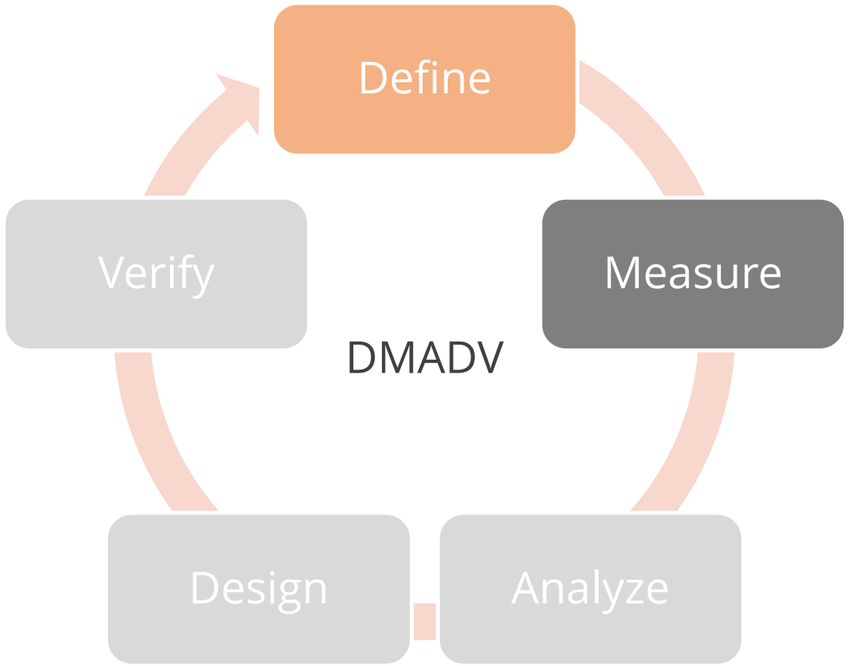


For **existing** products or services



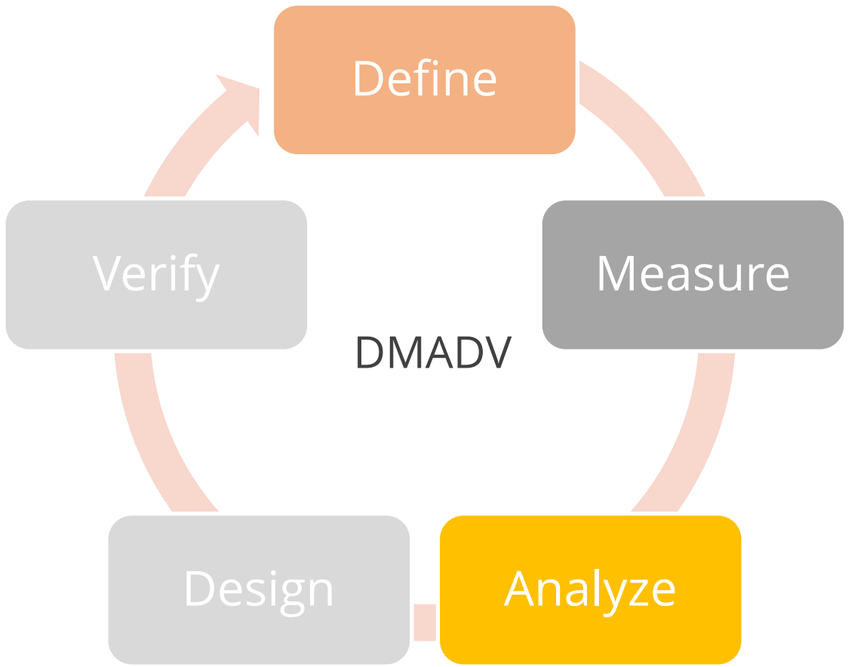
For **new** products or services

Explanation of DMADV



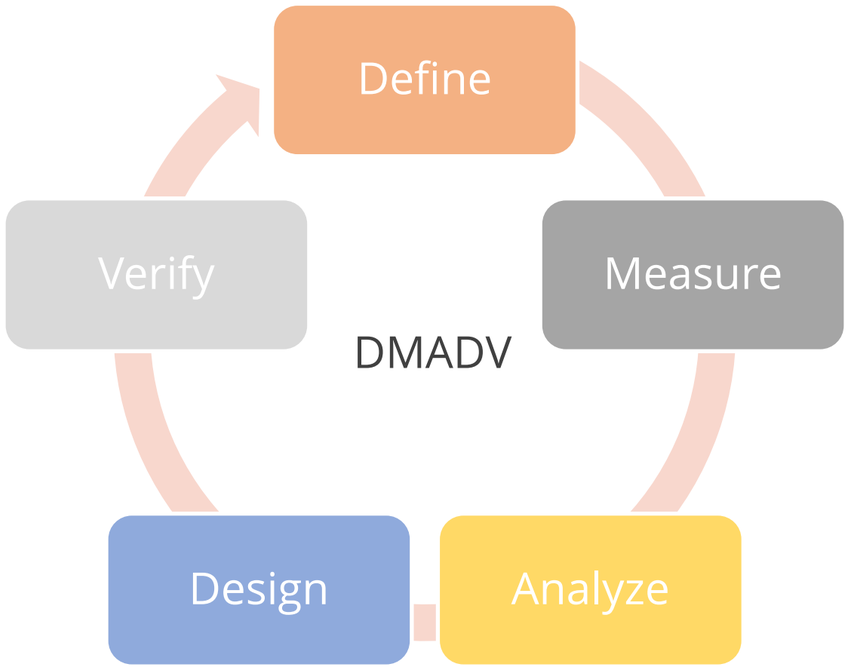
The performance is measured and matched to the customer requirements or benchmark.

Explanation of DMADV



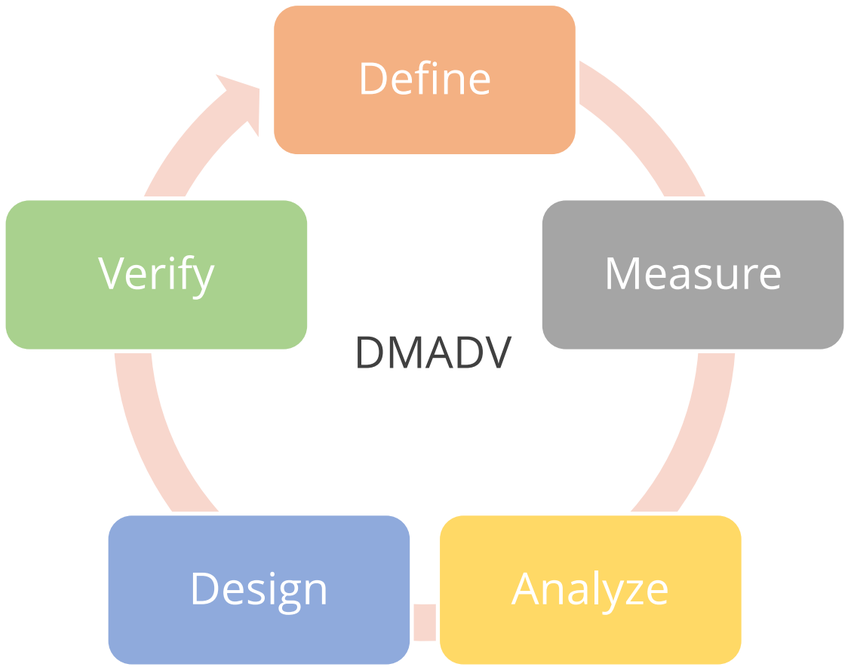
Design options are analyzed and assessed for the process, product, or service to meet customer needs.

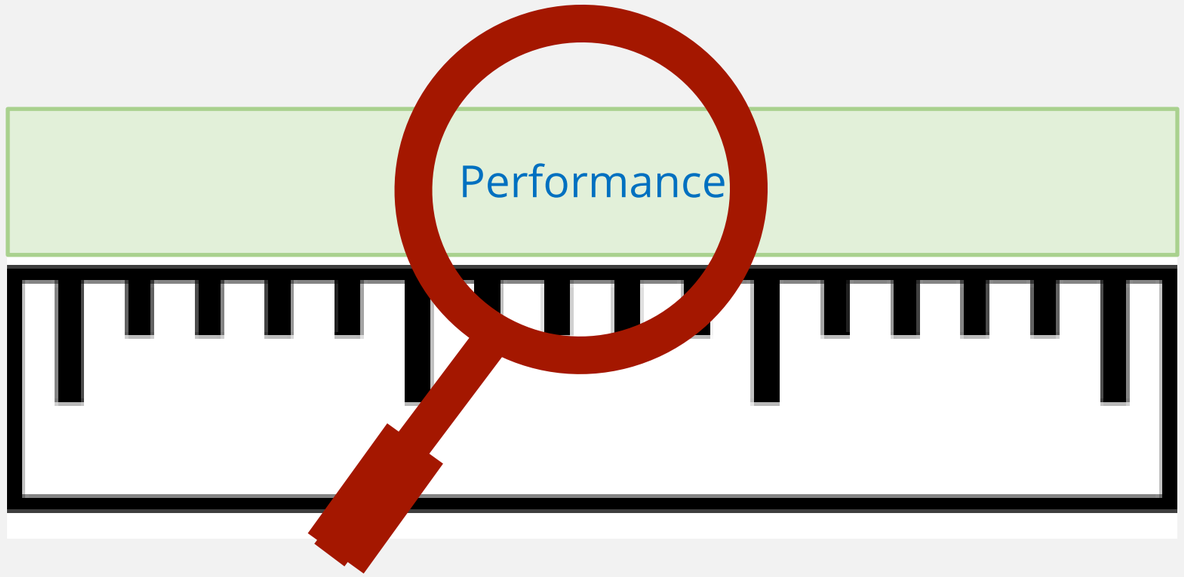
Explanation of DMADV



Design and implementation of new processes

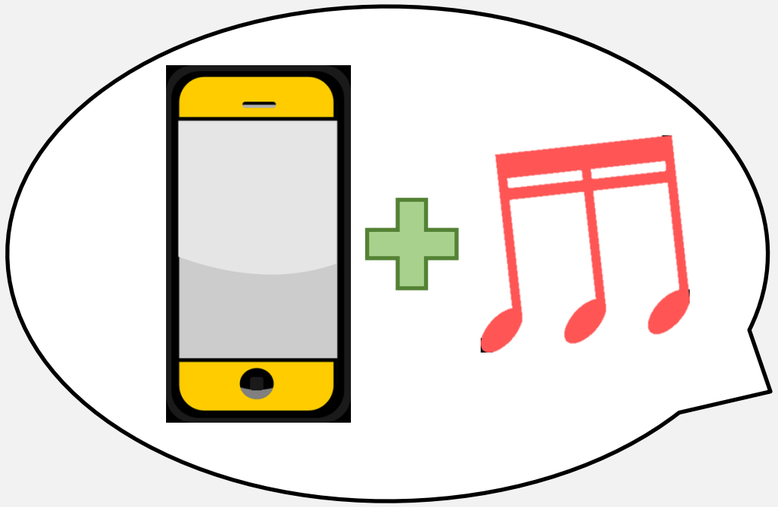
Explanation of DMADV



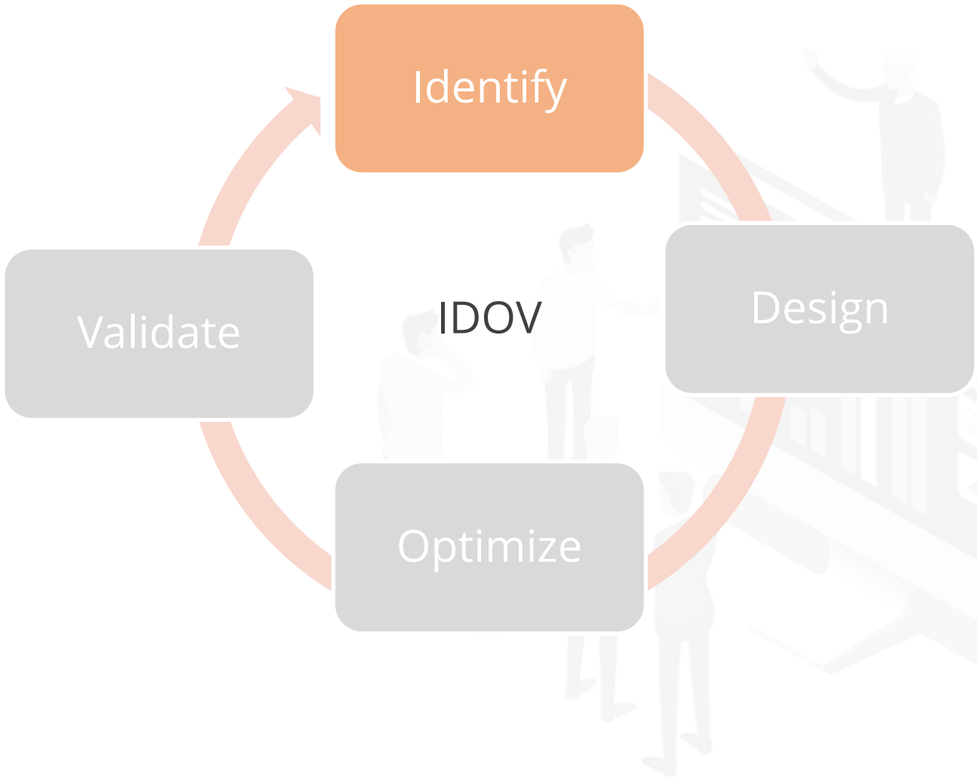


Results that meet customer needs are verified to maintain performance.

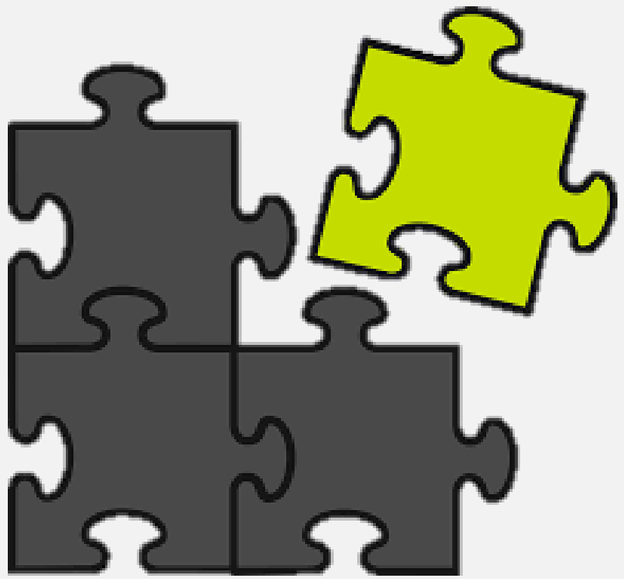
Explanation of IDOV



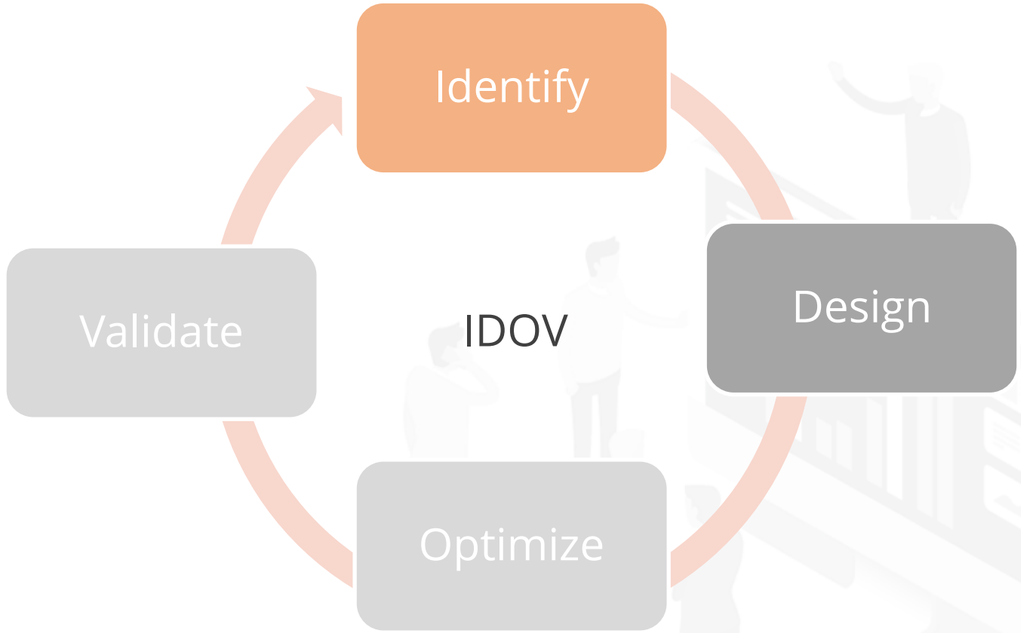
Customer needs and specifications are identified to design the product or service.



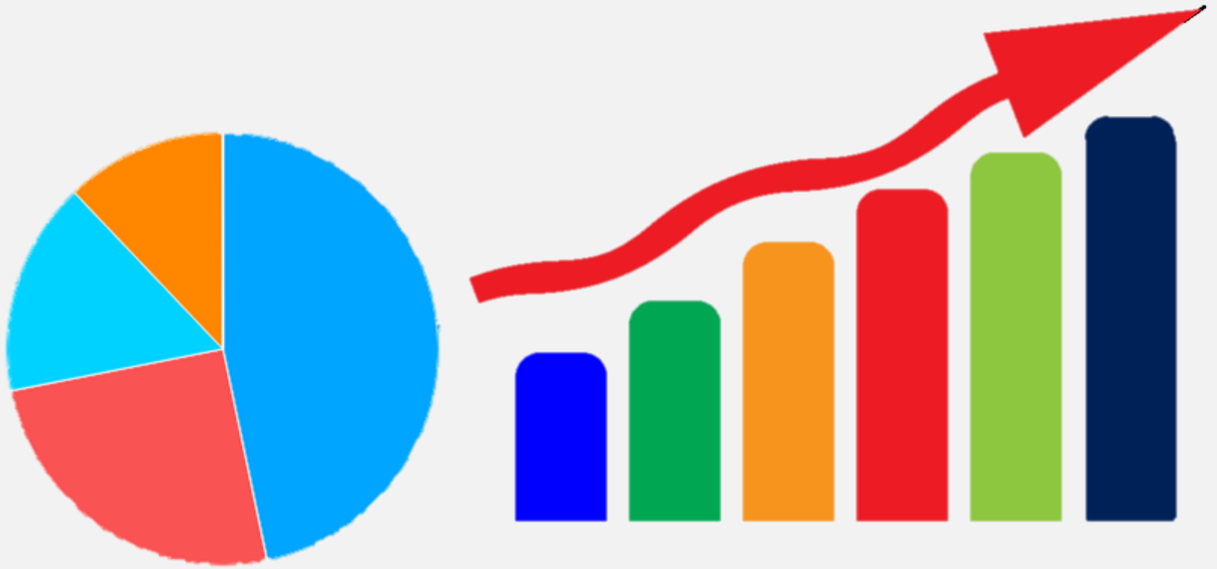
Explanation of IDOV



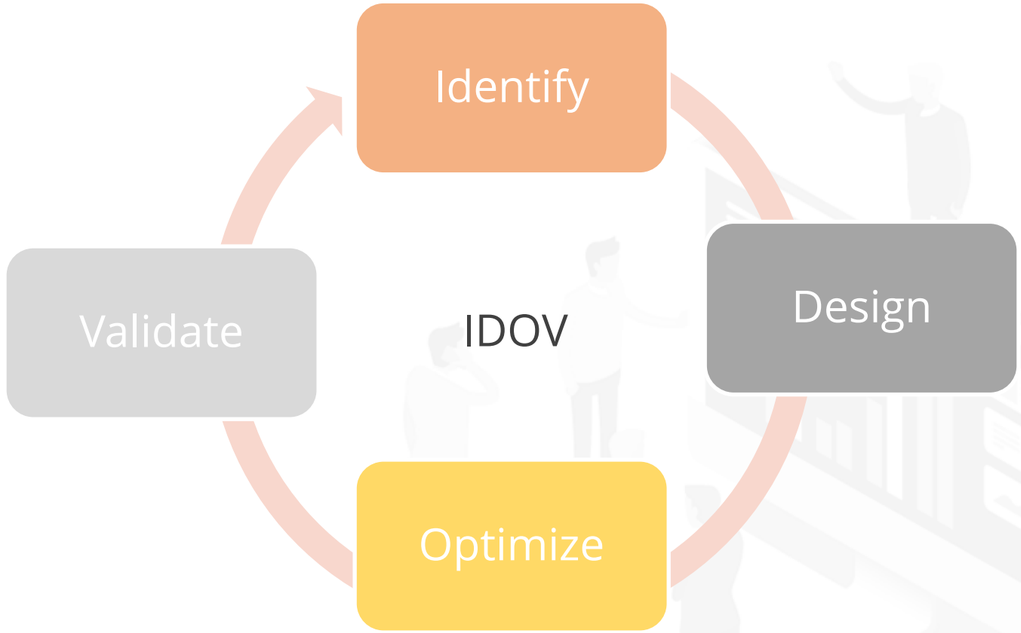
Design alternative solution concepts by identifying functional requirements, select the best fit, and predict Sigma capabilities.



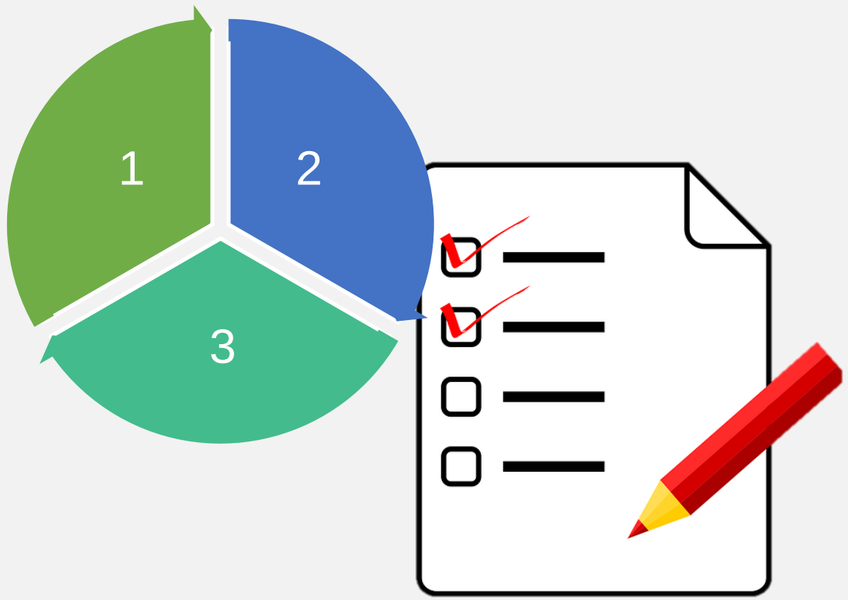
Explanation of IDOV



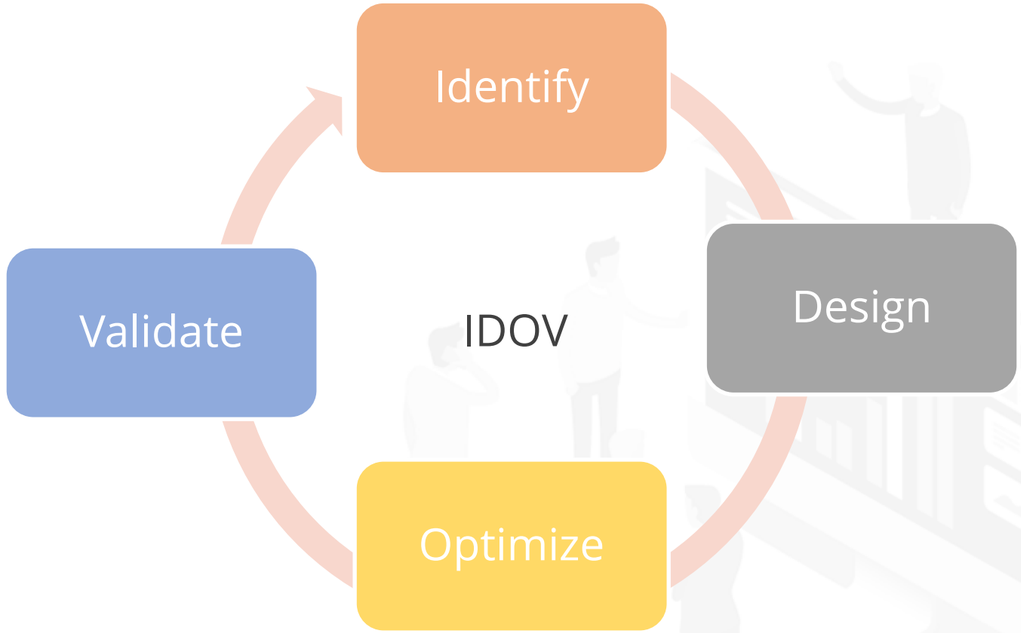
Optimize by calculating tolerance using statistical tools and modeling to predict performance.



Explanation of IDOV



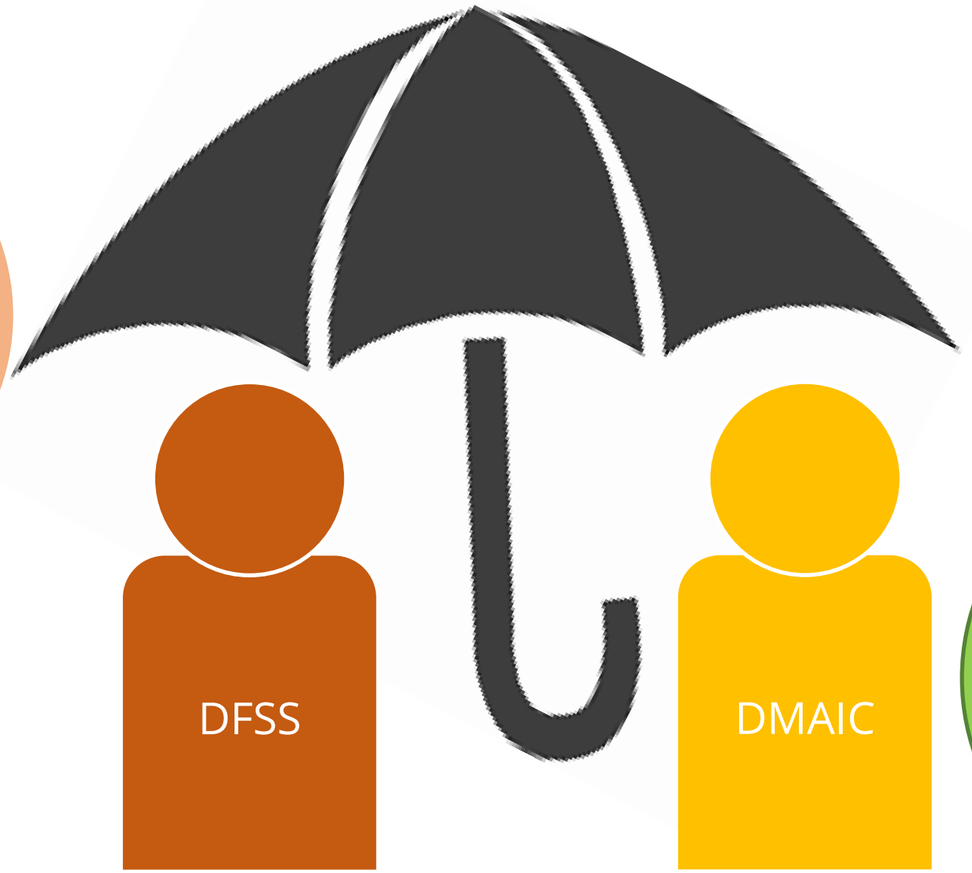
Verify the design by testing, validating, and checking conformance to Six Sigma Standards.



DFSS and DMAIC

Similarities

- Tools
- Six Sigma levels of performance
- Six Sigma philosophy



Differences

- DMAIC improves an existing process
- DMAIC focuses on one or two customer requirements
- Benchmarking is crucial for DFSS projects

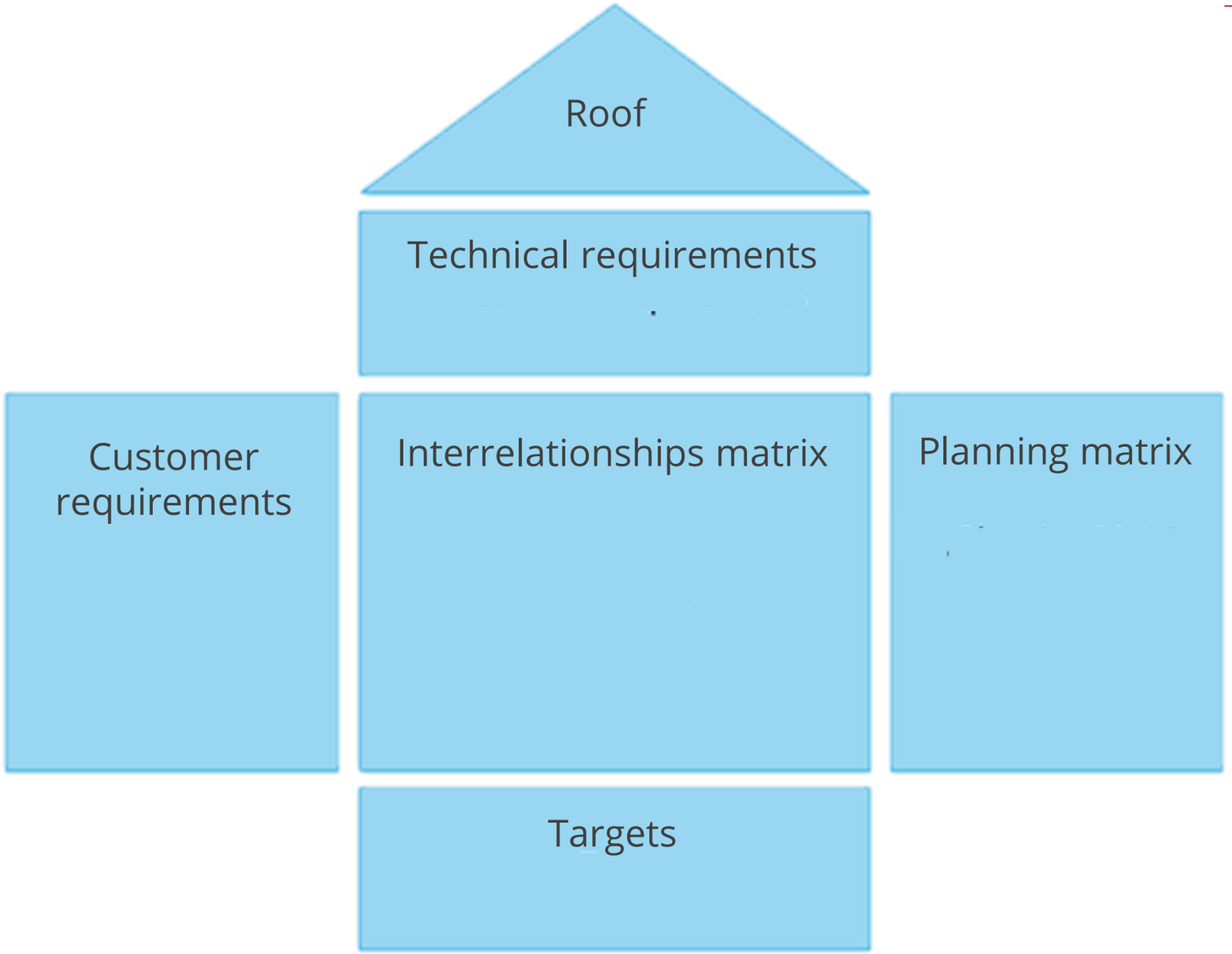
DIGITAL OPERATIONS

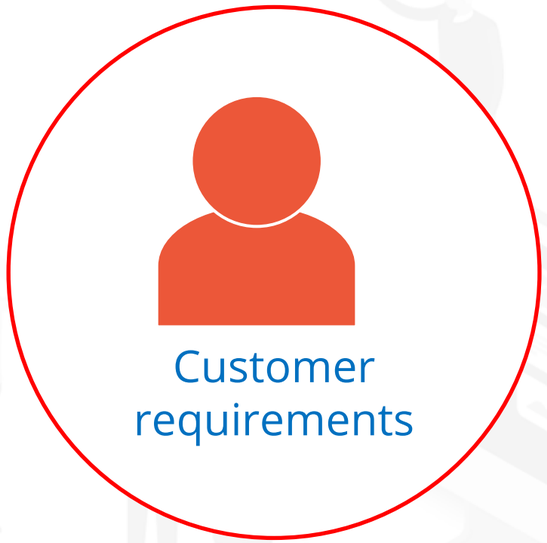
Goals and Six Sigma Projects

DFSS TOOLS

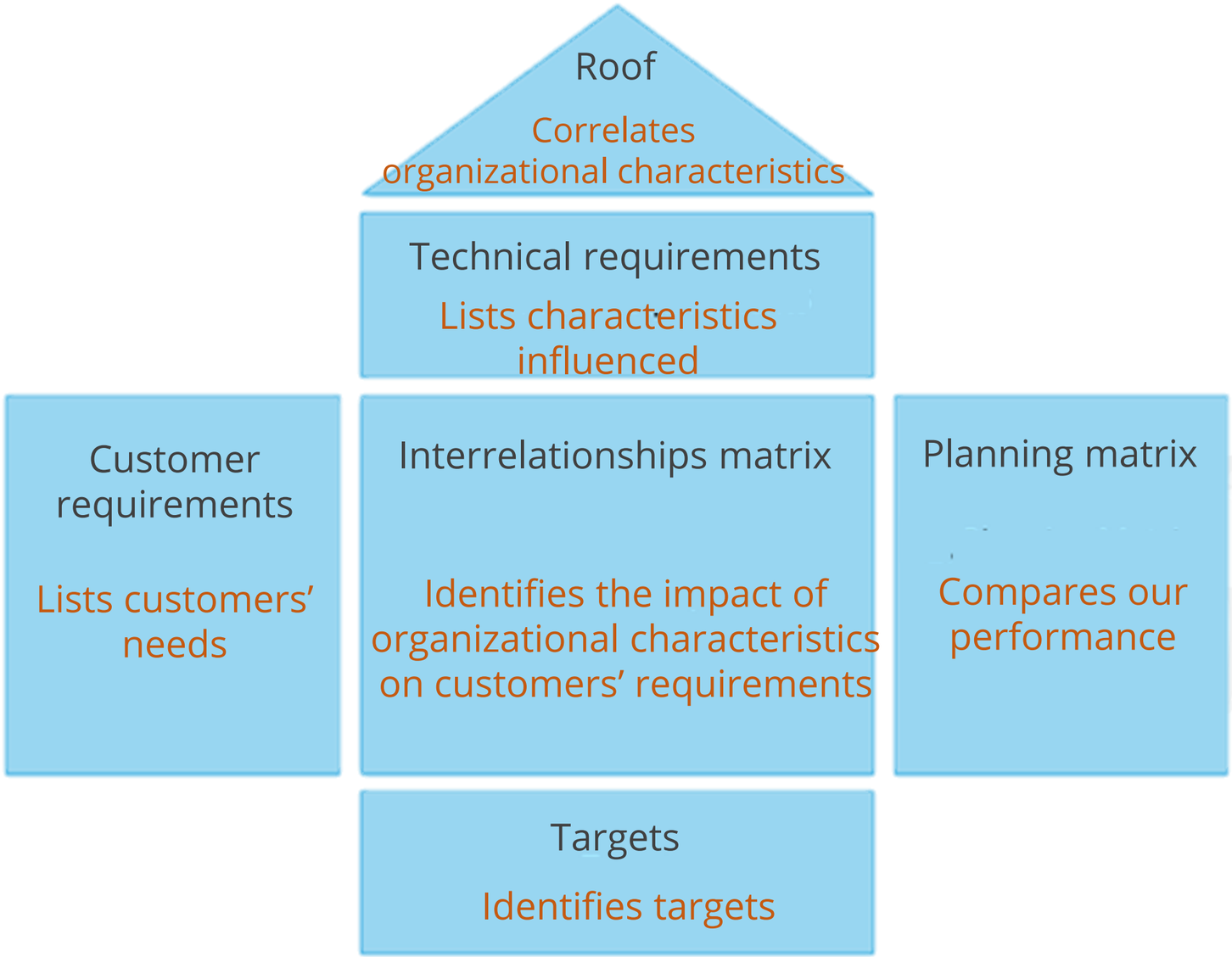
Quality Function Deployment (QFD)

QFD House of Quality (HOQ) Structure

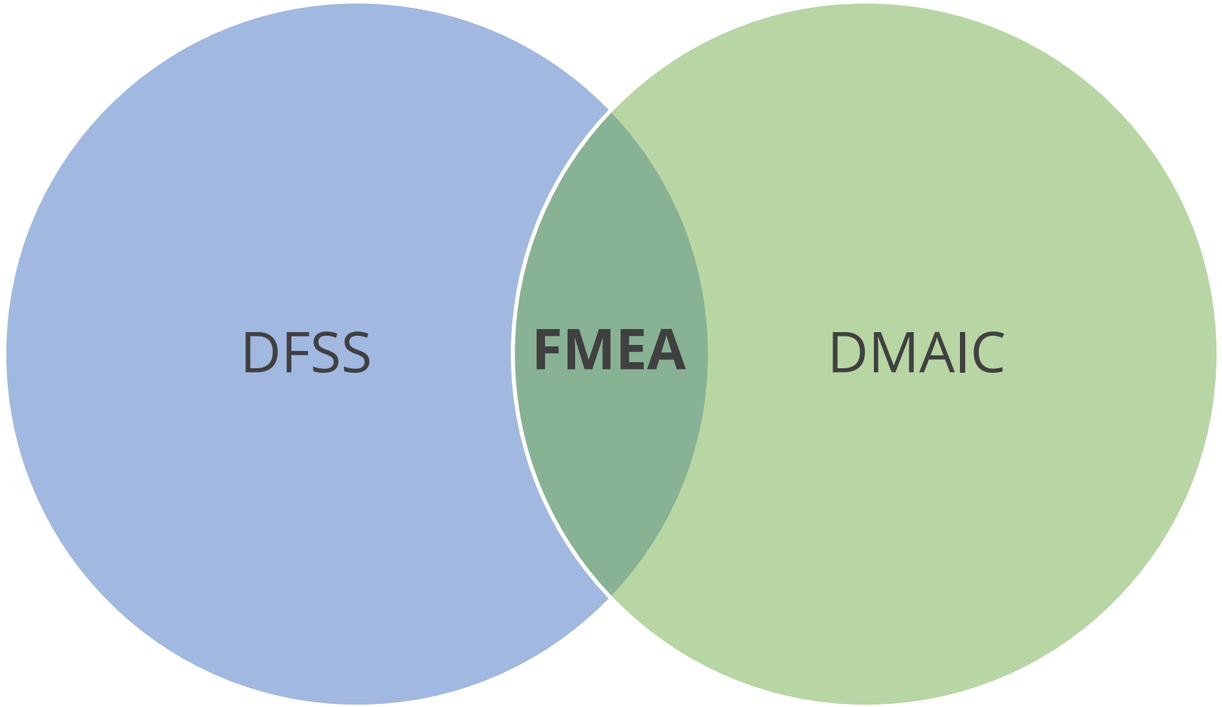




QFD House of Quality (HOQ) Structure



Failure Modes and Effects Analysis (FMEA)



- Identifies possible failures
- Identifies consequences of failure
- Prioritizes failure to see critical areas

FMEA Risk Priority Number (RPN)

FMEA Risk Priority Number (RPN) = Severity * Occurrence * Detection

Severity

1 — None — 10 — Hazardous

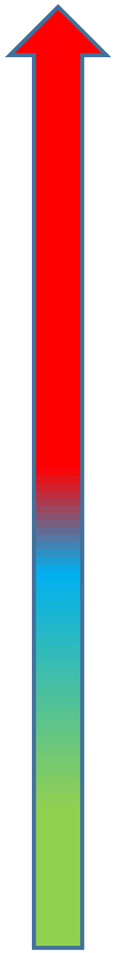
Occurrence

1 — Remote — 10 — Very high frequency

Detection

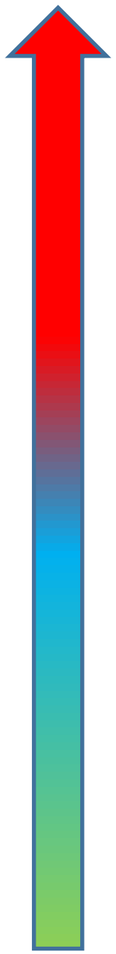
1 — Very detectable — 10 — Extremely undetectable

RPN and Scale Criteria: Severity



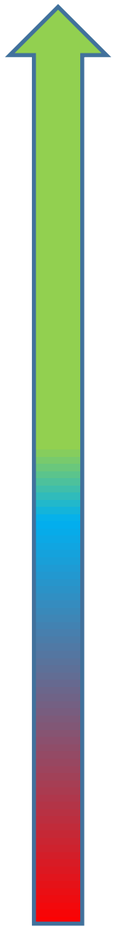
Effect	Severity of Effect	Rating
Hazardous without warning	Very high severity ranking when a potential failure mode affects safe system operation without warning	10
Hazardous with warning	Very high severity ranking when a potential failure mode affects safe system operation with warning	9
Very high	System inoperable with destructive failure without compromising safety	8
High	System inoperable with equipment damage	7
Moderate	System inoperable with minor damage	6
Low	System inoperable without damage	5
Very low	System operable with significant degradation of performance	4
Minor	System operable with some degradation of performance	3
Very minor	System operable with minimal interference	2
None	No effect	1

RPN and Scale Criteria: Occurrence



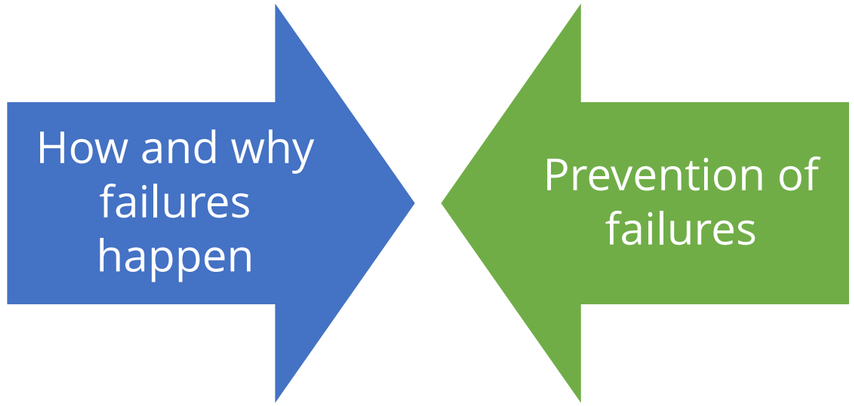
Effect	Failure Probability	Rating
Very High: Failure is almost inevitable due to this cause	>1 in 2	10
	1 in 3	9
High: Repeated failures due to this cause	1 in 8	8
	1 in 20	7
Moderate: Occasional failures due to this cause	1 in 80	6
	1 in 400	5
	1 in 2,000	4
Low: Relatively few failures due to this cause	1 in 15,000	3
	1 in 150,000	2
Remote: Failure is unlikely due to this cause	<1 in 1,500,000	1

RPN and Scale Criteria: Detection



Detection	Likelihood of detection by Design or Process Control	Ranking
Absolute uncertainty	Design/process control cannot detect potential cause/mechanism and subsequent failure mode	10
Very remote	Very remote chance the design/process control will detect potential cause/mechanism and subsequent failure mode	9
Remote	Remote chance the design/process control will detect potential cause/mechanism and subsequent failure mode	8
Very low	Very low chance the design/process control will detect potential cause/mechanism and subsequent failure mode	7
Low	Low chance the design/process control will detect potential cause/mechanism and subsequent failure mode	6
Moderate	Moderate chance the design/process control will detect potential cause/mechanism and subsequent failure mode	5
Moderately high	Moderately high chance the design/process control will detect potential cause/mechanism and subsequent failure mode	4
High	High chance the design/process control will detect potential cause/mechanism and subsequent failure mode	3
Very high	Very high chance the design/process control will detect potential cause/mechanism and subsequent failure mode	2
Almost certain	Design/process control will detect potential cause/mechanism and subsequent failure mode	1

FMEA Table to Plan Improvement Initiatives



Process Step	Key Process Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN
What is the process step?	What is the key process input?	In what ways does the key input go wrong?	What is the impact on the key output variables (customer requirements) or internal requirements?	How severe is the effect to the customer?	What causes the key input to go wrong?	How often does cause or Failure Mode (FM) occur?	What are the existing controls and procedures (inspection and test) that prevent the cause or the FM? Should include an SOP number.	How well can you detect cause or FM?	SOD

Types of FMEA

Process Failure Mode Effects Analysis (PFMEA)

Used on new or existing processes to uncover potential failures

Done in the quality planning phase to act as an aid during production

Involves fabrication, assembly, transactions, or services

Design Failure Mode Effects Analysis (DFMEA)

Used in the design of a new product to uncover potential failures

Aimed at identifying failure modes effects and reducing them

Done before product is sent to manufacturing

All significant design deficiencies are resolved at the end of this process

Applying FMEA in a Situation

FMEA Table

Process/ Product Characteristics	Potential Failure Mode(s)	Potential Effect(s) of failure	Sev (S)	Potential cause(s) of failure	Occ (O)	Current Design Control	Det (D)	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Taken	New Sev. (Sn)	New Occ (On)	New Det (Dn)	New RPN (RPNn)
Blades – Cut Hair	Too dull	Hair not cut close enough	7	Not sharpened properly in manufacturing	5	Capability verified	6	210	Statistical tolerancing	Management	Implemented	7	4	1	28
		Discomfort		Erosion	3	Supplier quality management plan and steel grade spec	3	63	None	N/A	N/A		3	3	63

Applying FMEA in a Situation

FMEA Table														
Process/ Product Characteristics	Potential Failure Mode(s)	Potential Effect(s) of failure	Sev (S)	Potential cause(s) of failure	Occ (O)	Current Design Control	Det (D)	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Taken	New Sev. (S_n)	New Occ (O_n)	New Det (D_n)	New RPN (RPN_n)
Cash withdrawal from ATM	Customer account debited but cash not paid	Extremely unhappy customer	9	Non-availability of cash in the ATM	7	Set minimum limit warning	2	126	Increase the set limit for regularly or often used ATM	Management	Minimum limit increased	9	4	1	36
				Network issue	5	None	9	405	Increase network limit	Technical and Management	Increased the limit and have load balancing		2	3	54

Tips and Tricks

Plan the FMEA analysis carefully.

Start the FMEA as soon as possible.

You need knowledge of systems operations to complete an FMEA.

You need knowledge of DFMEA before drawings are complete.

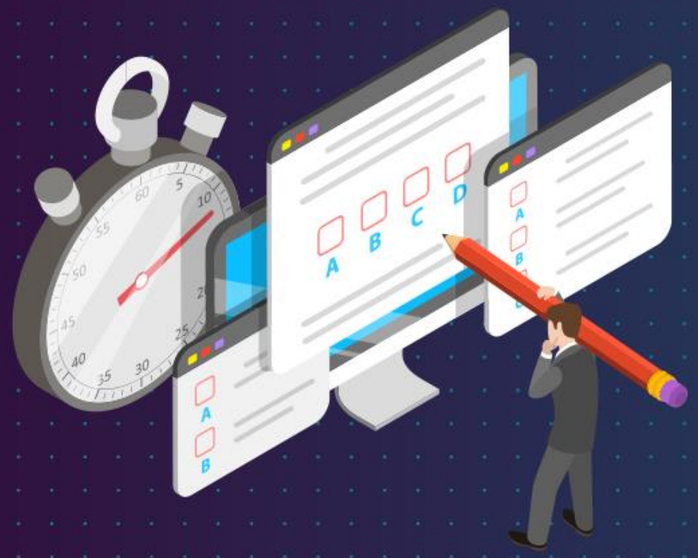
You need knowledge of PFMEA before production plans are final.

Key Takeaways

- DFSS is an approach that ensures a new product or service meets customer requirements.
- DMADV and IDOV are two types of DFSS methodologies.
- DFSS is a process at the Six Sigma level that uses tools such as QFD and FMEA.
- QFD is a focused methodology for carefully listening to the customers' needs or voice of the customer.

Key Takeaways

- FMEA is an approach to identify all possible failures in a design, process, product, or service.
- There are two types of FMEA: PFMEA and DFMEA.
- The FMEA RPN is a measure used to quantify or assess risk associated with a design, process, product, or service.



Knowledge Check

Knowledge Check

1

Which of the following is NOT a focus area for DFSS?

A. New processes

B. Fixing one element of existing process

C. New products or service

D. Adding to an existing product line

Knowledge Check

1

Which of the following is NOT a focus area for DFSS?

A. New processes

B. Fixing one element of existing process

C. New products or service

D. Adding to an existing product line

The correct answer is **B**

DFSS is focused on completely overhauling the process and not just one element.

Knowledge Check

2

Which of the following is NOT a DFSS methodology?

A. IDOV

B. DMAIC

C. DMADV

D. Identify, Define, Optimize, and Verify

Knowledge Check 2

Which of the following is NOT a DFSS methodology?

A. IDOV

B. DMAIC

C. DMADV

D. Identify, Define, Optimize, and Verify

The correct answer is **B**

DMAIC is not a DFSS methodology.

Knowledge Check

3

Which of the following is NOT true of DFSS?

A. It has focuses on quality.

B. Its purpose is to design a new process that meets customer needs.

C. It fits under the Six Sigma umbrella.

D. It targets only one customer requirement.

Knowledge Check

3

Which of the following is NOT true of DFSS?

A. It has focuses on quality.

B. Its purpose is to design a new process that meets customer needs.

C. It fits under the Six Sigma umbrella.

D. It targets only one customer requirement.

The correct answer is **D**

Design for Six Sigma, DFSS, ensures that all customer requirements are achieved.

Knowledge Check

4

What is the expansion of FMEA?

A. Failure Modules and Effects Analysis

B. Failure Modes and Effects Analysis

C. Failure Median and Effects Analysis

D. Failure Modes and Effort Analysis

Knowledge Check

4

What is the expansion of FMEA?

A. Failure Modules and Effects Analysis

B. Failure Modes and Effects Analysis

C. Failure Median and Effects Analysis

D. Failure Modes and Effort Analysis

The correct answer is **B**

FMEA stands for Failure Modes and Effects Analysis.

Knowledge Check

5

Which of the following is NOT a section in a QFD's HOQ matrix?

A. Customer Requirements

B. Roof

C. Basement

D. Planning Matrix

Knowledge Check

5

Which of the following is NOT a section in a QFD's HOQ matrix?

A. Customer Requirements

B. Roof

C. Basement

D. Planning Matrix

The correct answer is **C**

The six sections of a House of Quality (HOQ) matrix are customer requirements, planning matrix, technical requirements, interrelationship matrix, roof, and targets.