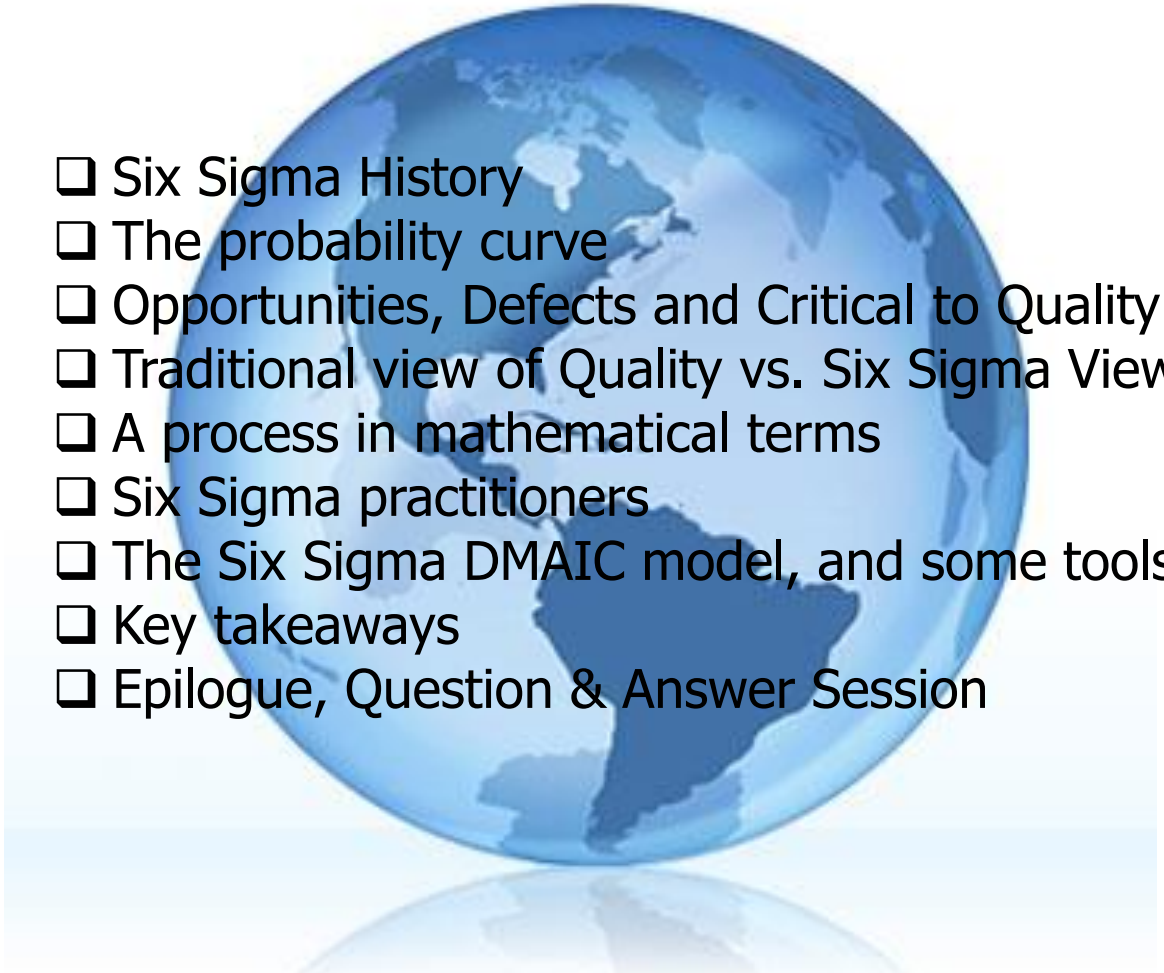
Introduction to Project Management, Lean & Six Sigma

Introduction to Six Sigma

The Roadmap



- Six Sigma History
- The probability curve
- Opportunities, Defects and Critical to Quality (CTQ's)
- Traditional view of Quality vs. Six Sigma View
- A process in mathematical terms
- Six Sigma practitioners
- The Six Sigma DMAIC model, and some tools
- Key takeaways
- Epilogue, Question & Answer Session

A brief history of Six Sigma

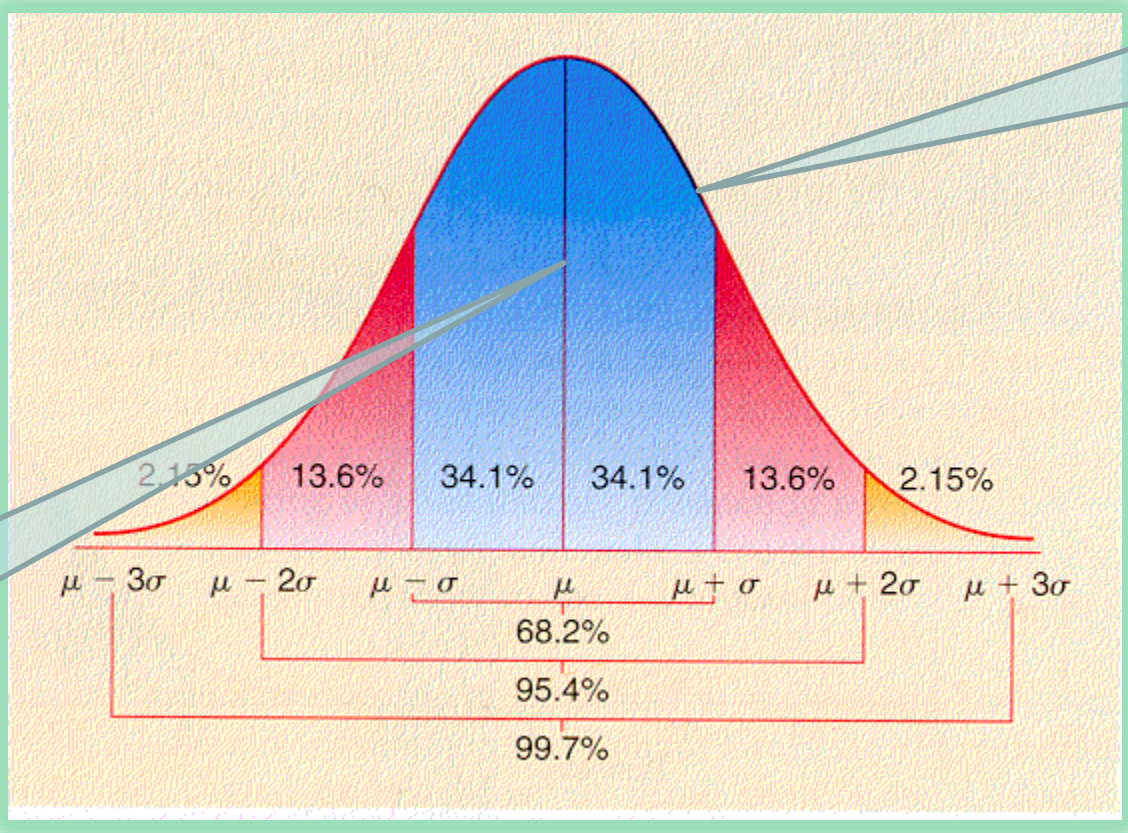
- Originally created to improve manufacturing processes by eliminating defects from the processes themselves.
- Evolved and developed by Motorola as part of a relentless, ongoing effort to improve the quality of their products.
  - Resulted in the creation of Motorola University and The Six Sigma Institute (1986)
  - In 1988, Motorola won the Malcolm Baldrige National Quality Award
- Adopted by General Electric and Jack Welch in 1995
  - Became an integral part of the GE culture
  - "changed the DNA of GE"
  - Formalized the methodology
    - CTQ (Critical to Quality)
    - VOC (Voice of the Customer)
    - DMAIC
    - ACFC (At The Customer for the Customer)

Source: Wikipedia

The Six Sigma probability curve

Sigma: the distribution (spread) about the mean (average) of any process.

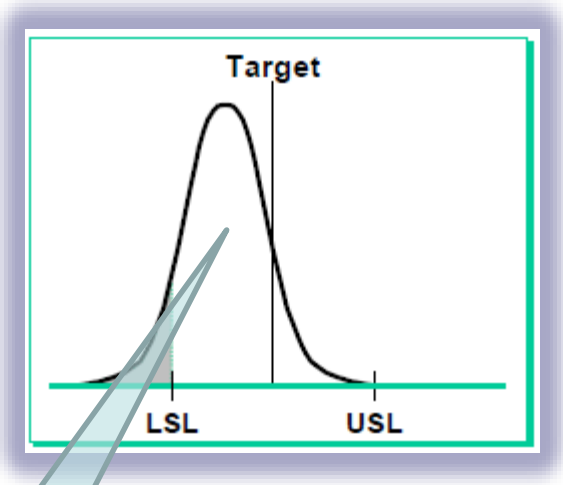
σ

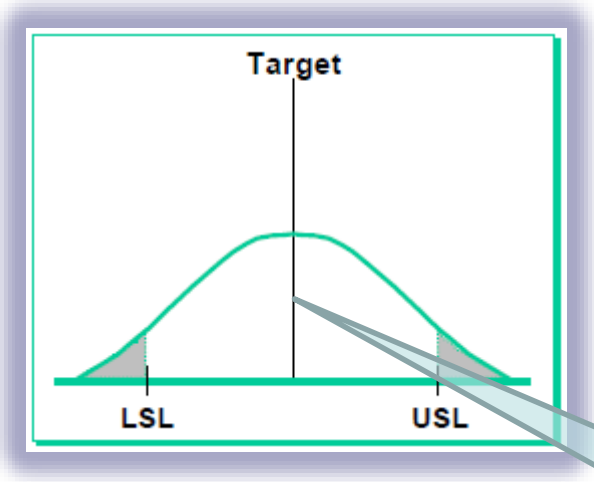


In a "normal" distribution of data, almost 100% (99.7) of occurrences should fall within between +/- 3 standard deviations (sigma) from the process average.

KEY IDEA
The natural enemy of developing a process with a high sigma (capability) is variability

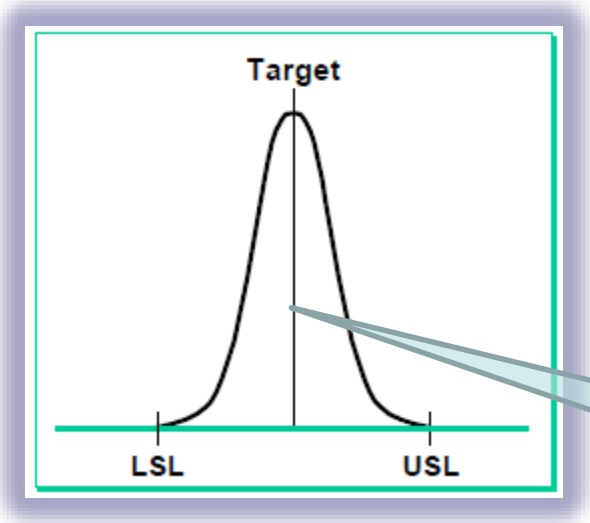
..what this means practically





The process may be operating predictable but not favorably

The process may have too much variation



Ultimate goal: a process operating as planned with little variation

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Opportunities, Defects and the CTQ

Opportunity: Any measurable event in a process that presents a chance of meeting a process specification.

Example: Phone calls for customer service coming into a call center

CTQ (Critical to Quality): A process attribute (specification) important to the process customer.

Example: Customer expects to speak with a CSR within two minutes of reaching the call center

Defect: A non-conformance to a CTQ.

Example: Any customer call in which it takes longer than two minutes to speak with a CSR.

How defects relate to Sigma

Defines the "Process Capability"

Defects per Million Opportunities

Sigma level	DPMO	Percent defective	Percentage yield
1	691,462	69%	31%
2	308,538	31%	69%
3	66,807	6.7%	93.3%
4	6,210	0.62%	99.38%
5	233	0.023%	99.977%
6	3.4	0.00034%	99.99966%

Sigma measures the capability of a particular process to perform "defect free" work

Source: Wikipedia

Traditional vs. Six Sigma view of quality

Process	"Traditional" Quality View	Six Sigma Quality View
	"99% good" (3.8σ)	"99.99966% good" (6σ)
	20,000 lost mail pieces per hour	7 lost mail pieces per hour
	5,000 incorrect surgical procedures per week	1.7 incorrect surgical procedures per week
	200,000 wrong prescriptions per year	68 wrong prescriptions per year

SHIFT

A Process in mathematical terms

"Y" is the process output

Output is produced as a function of one or more inputs or x's

$$y = f(x)$$

Historically, fixing a process has focused on the "Y", Six Sigma shifts focus to the x's

Let's examine both sides of the equation:

"Y"	"$x_1 \ldots x_n$"
Dependent Variable	Independent Variable
Process Output	Process Input
Effect	Cause
Symptom	Problem
Monitor	Control

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Six Sigma Practitioners

Yellow Belt (YB):

- Possesses a basic knowledge of the Six Sigma methodology
- Serves as a SME (Subject Matter Expert) on projects
- Identify process improvement candidates in the business

Green Belt (GB):

- Thoroughly trained in Six Sigma improvement methodology
- "Embedded" in the business in which they operate
- Conduct projects as part of their full-time jobs

Black Belt (BB):

- Possess a deep knowledge of Six Sigma
- Knowledgeable and skilled in the use of the tools and methodology
- Runs improvement projects as full-time role
- Coaches green belts on completion of projects

Master Black Belt (MBB):

- Expert practitioners of Six Sigma improvement methodology
- Responsible for strategic implementations in organizations
- Provide coaching for Black Belts and Green Belts

Keep in mind: These definitions will vary from business to business

Champions take responsibility for Six Sigma implementation across the organization in an integrated manner.

The key precepts of Six Sigma

The Six Sigma focus:

- The Customer – what is most important to him/her
- Improvements that are driven by revelations in data
- Inputs (X's) to the process
- The reduction or total elimination of process defects
- Reducing the amount of variation in a process
- Improving the capability of a process

Sigma – Describes both the capability of a process and the amount of variation in that process.

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Reengineering a Process to 6σ – The DMAIC model

The DMAIC methodology follows a fairly rigorous twelve (+3) step process geared toward taking existing processes and reengineering them towards a greater process capability (sigma).

DEFINE –

A. Identify the project CTQ's
B. Establish a project charter
C. Lay out the existing process map

MEASURE –

1. Select specific CTQ characteristics
2. Define the particular performance standards
3. Execute a Measurement System Analysis

ANALYZE –

4. Calculate the current process capability (sigma)
5. Identify performance objectives of the process
6. Identify potential sources of variation in the process

Motorola originally developed the process as 12 steps. When GE adopted it, they added the 3-step "define" piece in front

Reengineering a Process to 6σ -- The DMAIC model

IMPROVE –

7. Determine vital X's (inputs) that are causing variation
8. Identify relationships between the vital X's
9. Establish what tolerances that the X's should operate under

CONTROL –

10. Validate measurement system on current process inputs
11. Calculate the new process capability (sigma)
12. Implement a system of process control

The framework for Six Sigma

The 12 Step Process

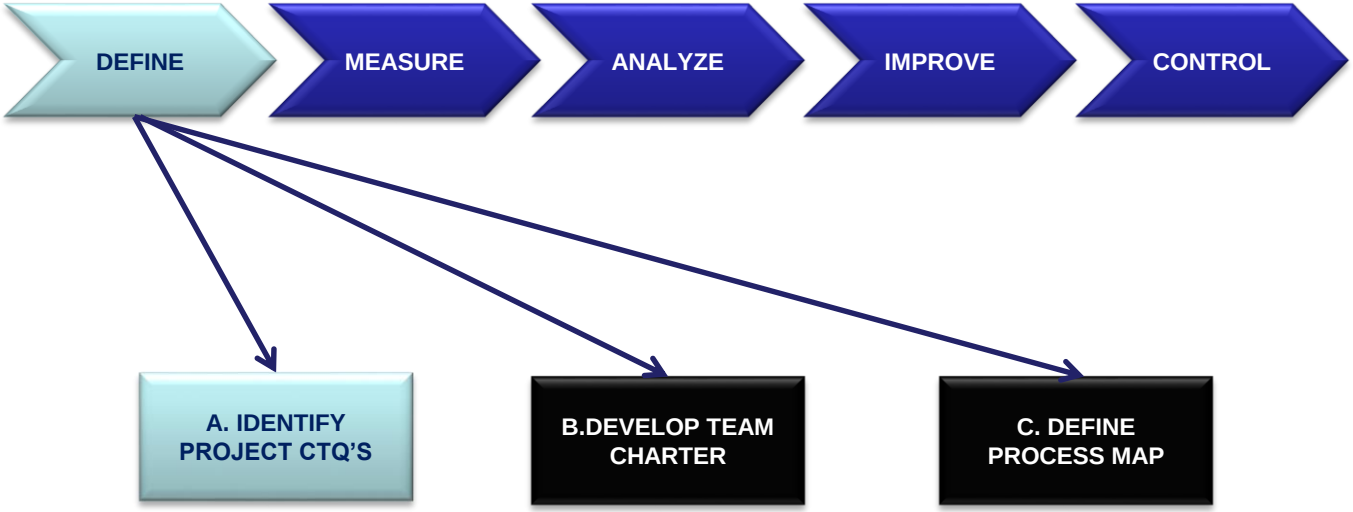
Step	Description	Focus	Tools	SSQC Deliverables
Define				
A	Identify Project CTQs			Project CTQs (1)
B	Develop Team Charter			Approved Charter (2)
C	Define Process Map			High Level Process Map (3)
Measure				
1	Select CTQ Characteristics	Y	Customer, QFD, FMEA	Project Y (4)
2	Define Performance Standards	Y	Customer, Blueprints	Performance Standard for Project Y (5)
3	Measurement System Analysis	Y	Continuous Gage R&R, Test/Retest, Attribute R&R	Data Collection Plan & MSA (6), Data for Project Y (7)
Analyze				
4	Establish Process Capability	Y	Capability Indices	Process Capability for Project Y (8)
5	Define Performance Objectives	Y	Team, Benchmarking	Improvement Goal for Project Y (9)
6	Identify Variation Sources	X	Process Analysis, Graphical Analysis, Hypothesis Tests	Prioritized List of all Xs (10)
Improve				
7	Screen Potential Causes	X	DOE-Screening	List of Vital Few Xs (11)
8	Discover Variable Relationships	X	Factorial Designs	Proposed Solution (13)
9	Establish Operating Tolerances	Y, X	Simulation	Piloted Solution (14)
Control				
10	Define & Validate Measurement System on X's in Actual Application	Y, X	Continuous Gage R&R, Test/Retest, Attribute R&R	MSA
11	Determine Process Capability	Y, X	Capability Indices	Process Capability Y, X (15)
12	Implement Process Control	X	Control Charts, Mistake Proof, FMEA	Sustained Solution (15), Documentation (16),

The *DMAIC* Process

Define	**1. Customer expectations of the process?**
Measure	**2. What is the frequency of defects?**
Analyze	**3. Why, when, and where do defects occur?**
Improve	**4. How can we fix the process?**
Control	**5. How can we make the process stay fixed?**

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Step A Identify the CTQs

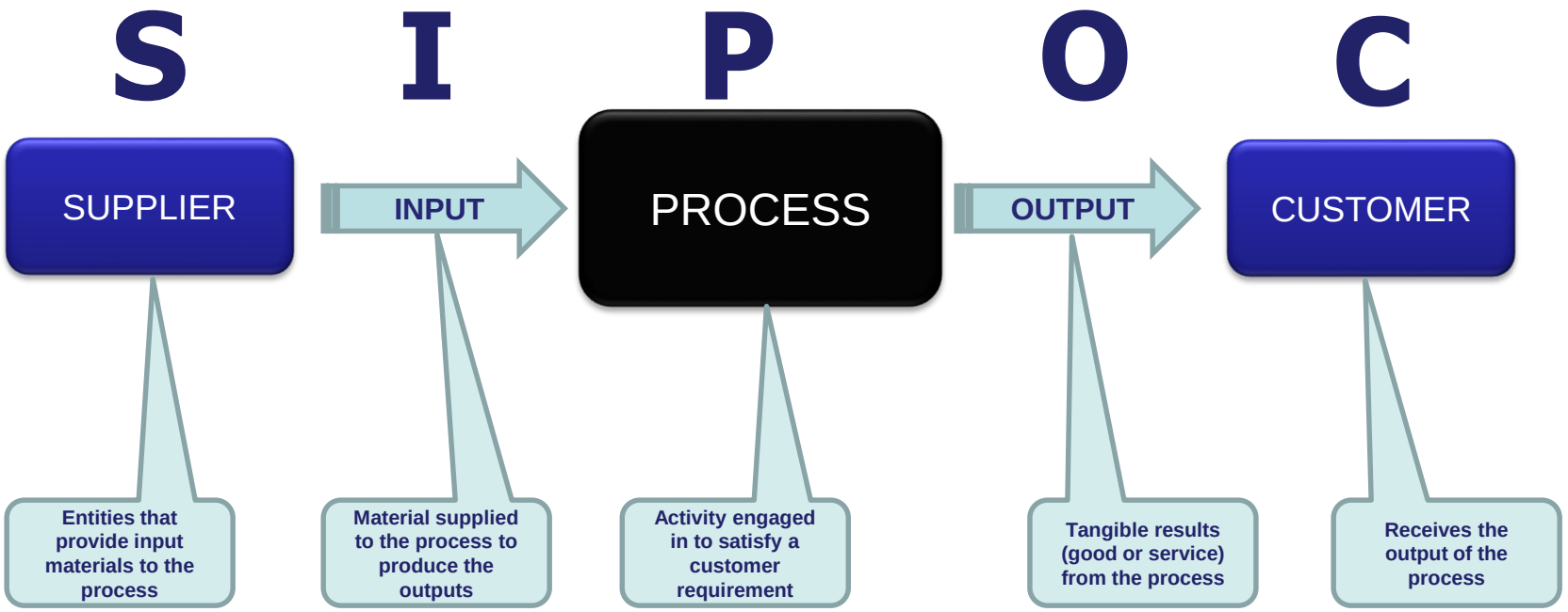


DELIVERABLES

- Identify Customer(s)
- Identify what is Critical-to-Quality (CTQ's)

How do we locate the customer?

Let's break it down…



What is critical to the quality of the process, from your customer's perspective?

If you focus on the customer call it *COPIS*

VOC defined

What is critical to the quality of the process, from your customer's perspective? – Voice of the Customer

Possible Sources of VOC:

- Benchmark Data/Metrics
- Customer Complaints
- Customer Surveys
- Business Goals & Objectives
- Executive Scoreboards & Dashboards
- Focus Groups

KEY IDEA:

Identify & Quantify customer needs in order to develop strategies to address them

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Tools to gather customer VOC

SURVEYS

Pros:

- Low Cost approach
- Good response rates (by phone)
- Can produce quicker results

Cons:

- Mail surveys…can get incomplete results, skipped questions, unclear understanding
- Poor response (by mail)

WORKOUT/ FOCUS GROUP

Pros:

- Group interaction generates information
- Deeper responses
- Cover more complex questions or qualitative data

Cons:

- Small sample-- difficult to generalize
- Data collected typically qualitative vs. quantitative

INTERVIEWS

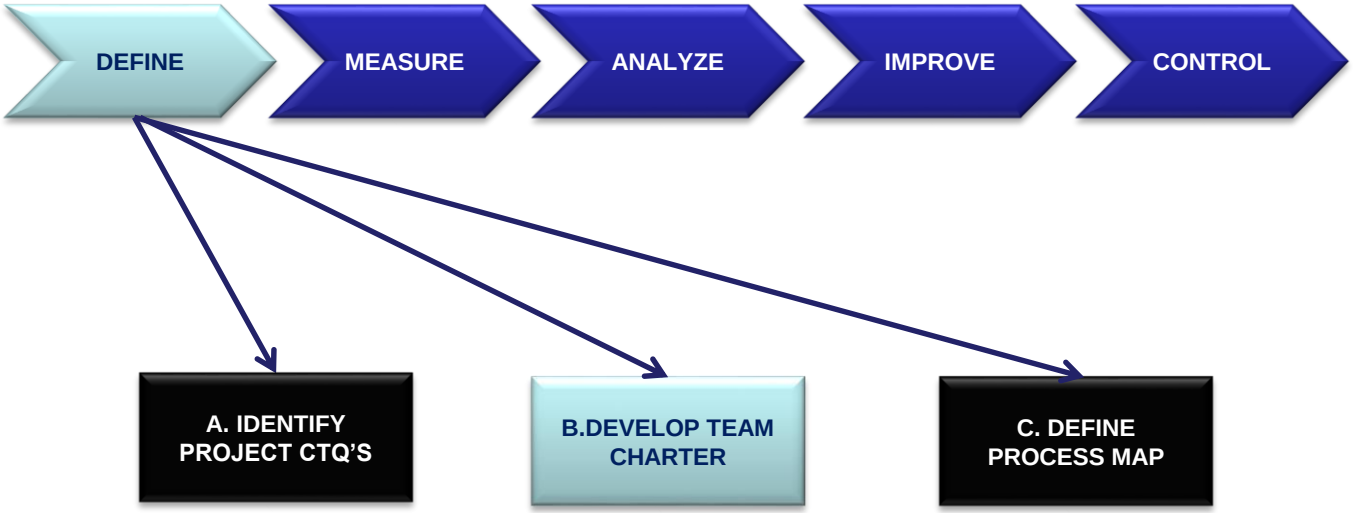
Pros:

- Can tackle complex questions
- Good choice when people won't respond willingly and/or accurately by phone/mail

Cons:

- Long time to complete
- Requires trained, experienced interviewers

Step B The Charter



DELIVERABLES

- Identify the Business Case
- Formulate Problem Statement
- Formulate Goal Statement
- Determine Project **Scope**
- Build team & roles
- Set appropriate milestones

Charter Objectives

What objectives does the charter satisfy?

- Clarification of what expectations the team is operating under
- Aids in helping the team keep focus on the objective
- Insures that the team is aligning properly with strategic priorities
- Gives the project manager/Six Sigma professional the authority to perform the work

"Authority" here is implicit NOT explicit in most cases

Step B- The Charter

A project charter may contain (though not necessarily be limited to) the following:

- Project title
- Problem & Goal statements
- Scope (both what's in ***and*** what's out)
- Project manager name and contact information
- Summary schedule or timeline
- Summary of the project's estimated cost and budget allocation
- Description of the project objectives, including the business need or other justification for authorizing the project
- Project success criteria, including project approval requirements
- A roles and responsibilities matrix (RACI)
- A sign-off section for signatures of key project stakeholders

Sample Charter

Business Case:

Currently, EMSI is Genworth LTC's sole vendor for the acquisition of APS's that are necessary to underwrite Long Term Care insurance applications. Genworth's single-vendor sourcing of this service exposes the company to great financial risk.

Problem Statement:

No processes/infrastructure are currently in place to support the supply of APS's by multiple service providers. Absence of these processes limits Genworth LTC's ability to exercise flexibility in the selection of providers that will provide the greatest cost benefit and/or level of service that the business desires. A 'sole-source' situation exposes Genworth to potential revenue loss should that source become unable to provide APS's in a timely fashion.

Goal Statement:

- Processes and infrastructure in place to readily add and remove vendors as suppliers of APS's by June 30th , 2005* (estimated)
- Initial BCP implemented for emergency fulfillment situations by April 15th, 2005

In Scope:

All functions related to APS fulfillment:

- Ordering
- Transmission
- Billing
- Payment
- Processing
- Reporting

Start / Stop Points for Project:

Start: APS order placement with vendor by Genworth or approved third party

Stop: Payment issued to vendor

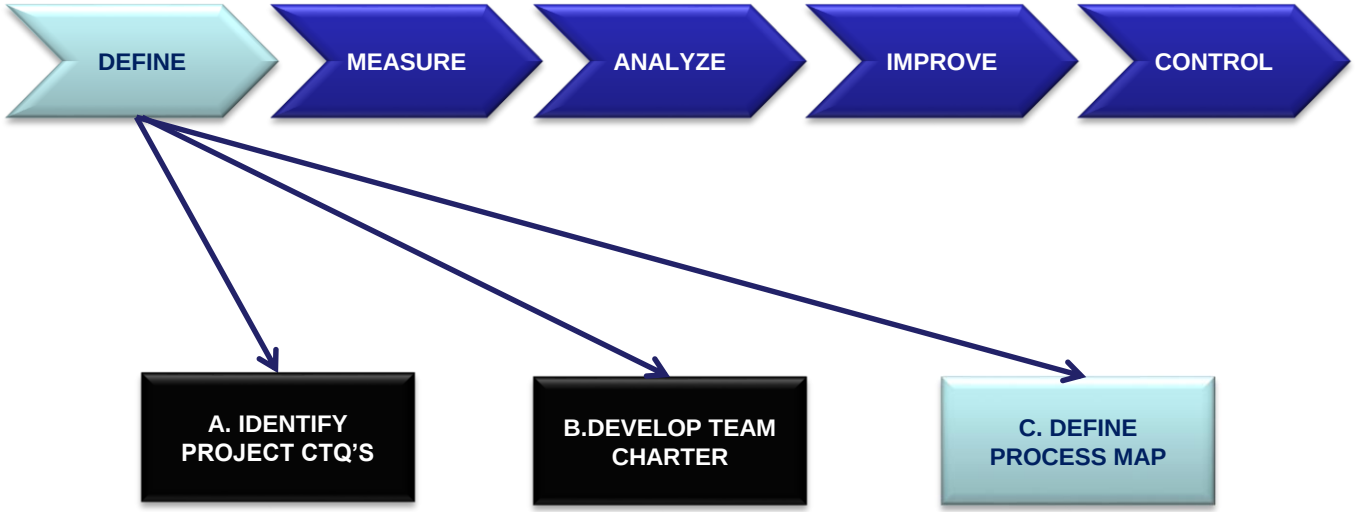
Key Deliverables:

- APS ordering mechanisms & repeatable processes in place for onboarding APS vendors.
- Appropriate electronic feeds to GNW back-end systems established
- Status report/error resolution processes in place
- Quality assurance processes established
- Billing & payment processes in place
- Establish operating level of business with new vendor
- Business Continuation Plan formulated for APS fulfillment.

Key Service Level Requirements (SLR's)::

- Order status files delivered to GNW in NAILBA format
- APS images delivered to GNW in TIFF image format
- Image index files delivered to GNW in flat-text CSV format
- APS authorizations to vendor handled by imaging
- Field (agent) orders can be handled via fax
- Vendor uses existing status codes used with EMSI
- Vendor has readily-accessible teams for problem resolution

Step C The Process Map

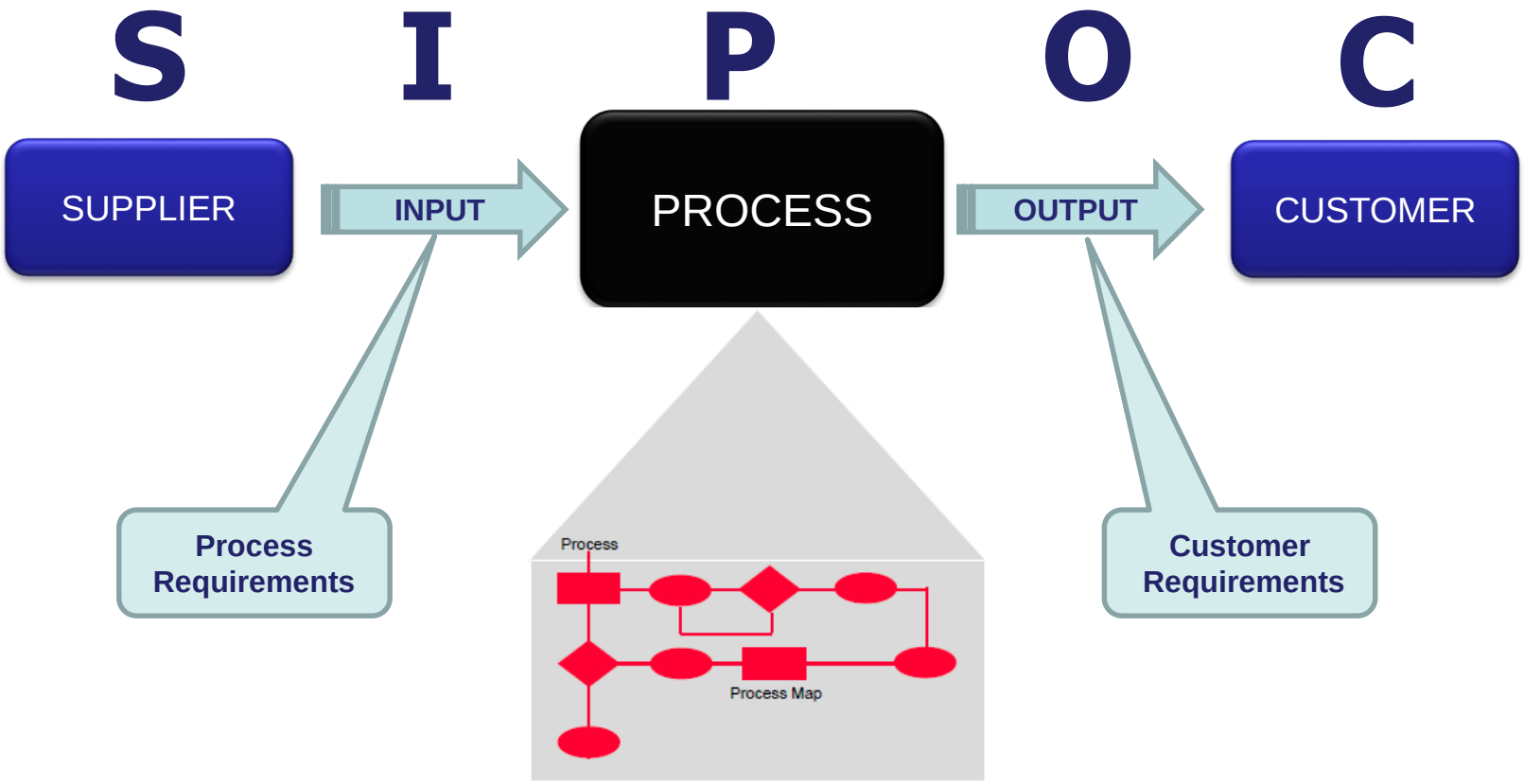


DELIVERABLES

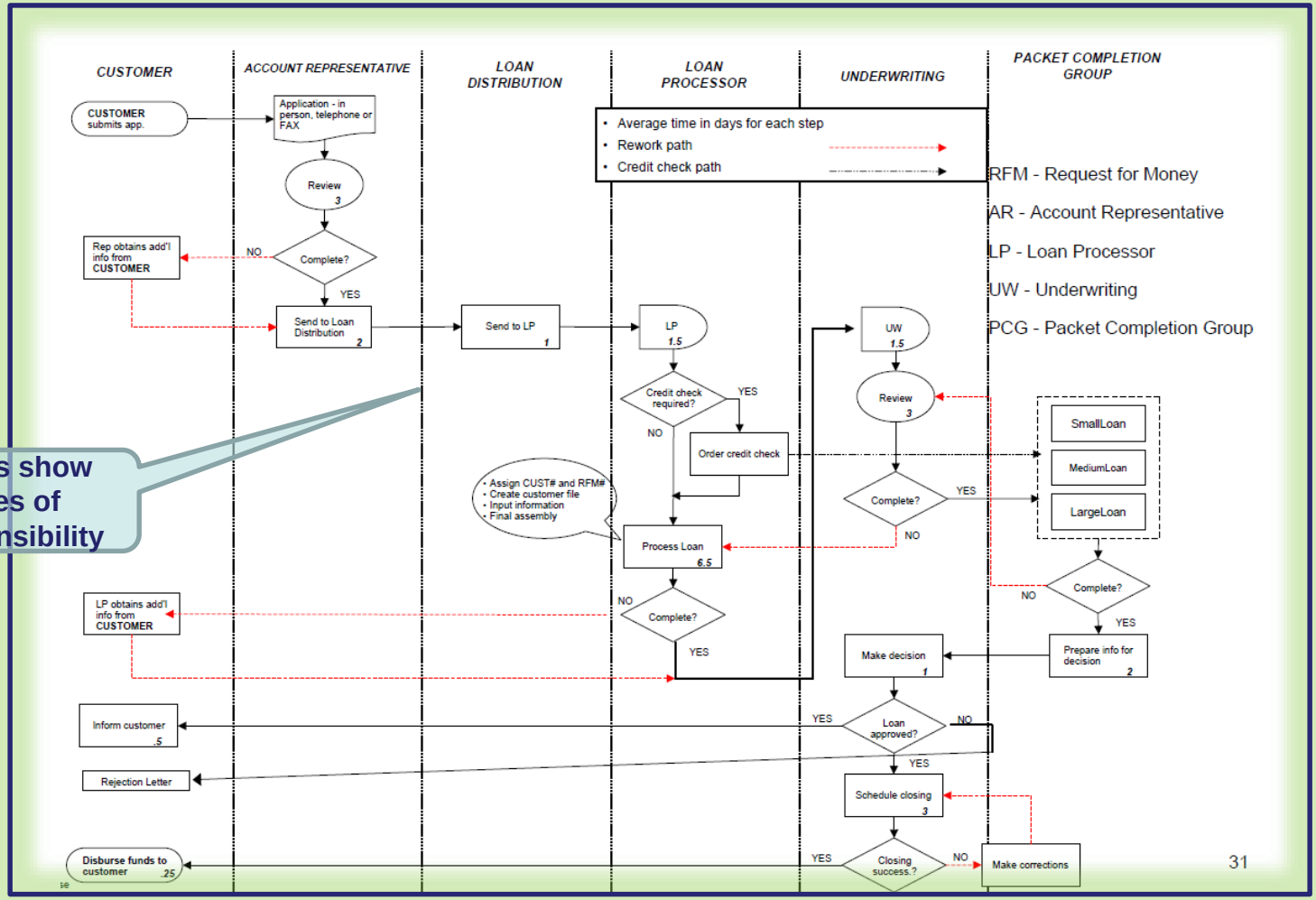
- Build the process map

The Process Map

Key Idea: Connect your customer to the process

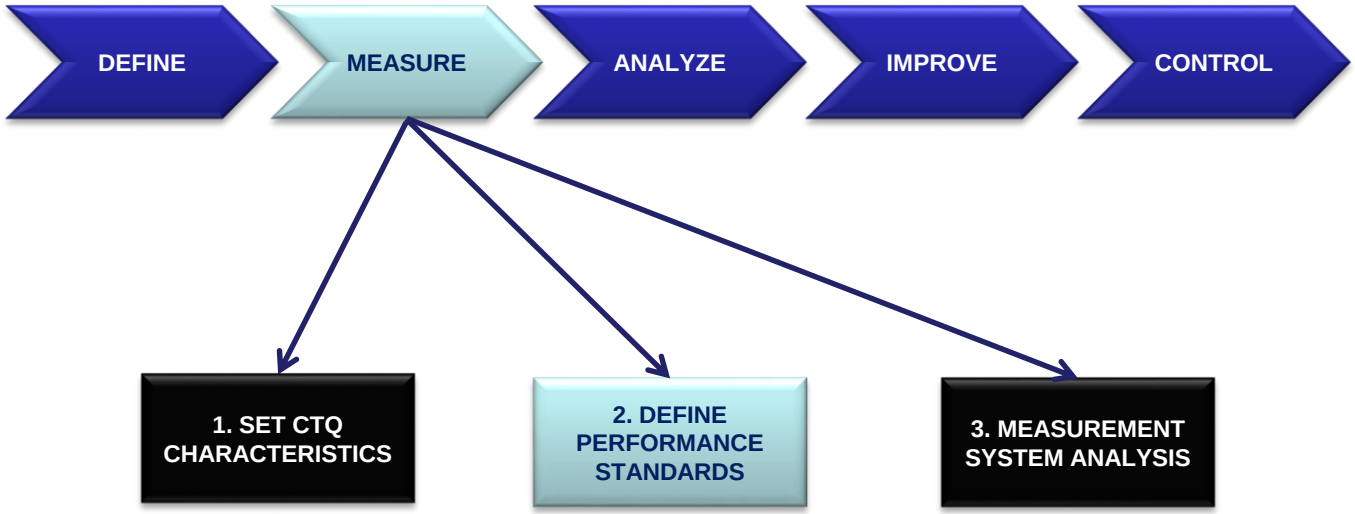


The Process Map (with swim lanes)



Lanes show lines of responsibility

Step 2 Performance Standards



DELIVERABLES

- Determine the specification limits for the performance of the process (the Y)

Opportunities and Defects
A review

Opportunity: Any measurable event in a process that presents a chance of meeting a process specification.

Defect: A non-conformance to a CTQ.

Clear definition

Performance Standards: Requirement or specification of the customer

- What the customer wants
- What determines quality
- What does a "defect" look like

Identification of a defect requires a clear operational definition.

What an Operational Definition looks like

What is it: A precise definition that specifies how to get a value for the CTQ characteristic that you will measure.

Provides clarity:

- What is being measured
- How it will be measured
- Measurement process is consistent

For example: What constitutes an "on-time" departure for a plane flight?

- Door to the jetway closed prior to departure?
- Plane taxis onto the runway?
- Plane leaves the ground?

An Operational Definition for timely departures

An operational definition for timely departures:

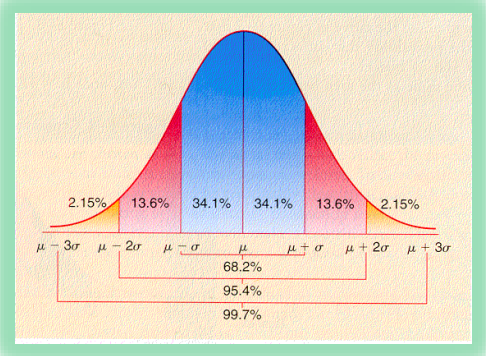
- What is being measured – Time between jetway door closing and stated departure time
- How it will be measured – Elapsed time (granularity to seconds)
- Measurement process – Digital stopwatch

Establish a performance target

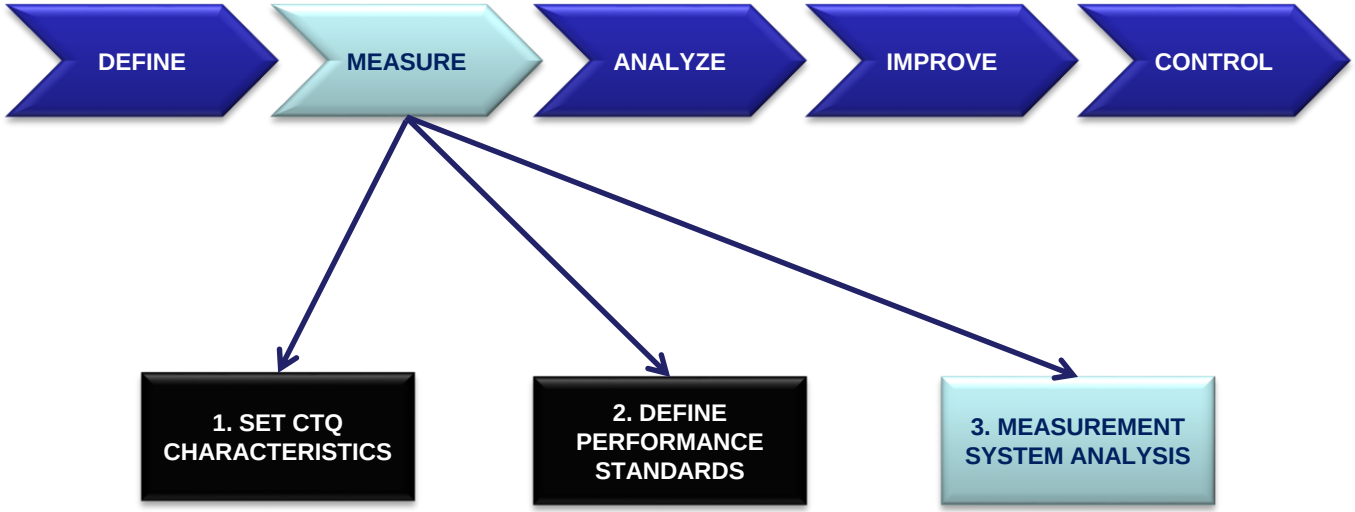
A possible scenario:

- Expected CTQ: Departure within 5 minutes (300 seconds) of stated time
- Opportunity: Each departure during a given week
- Defect: Any departure more than 5 minutes

Key Idea: Clearly articulate the customer expectation, what constitutes an opportunity for non-conformance, and what the non-conformance is



Step 3 Measurement System Analysis



DELIVERABLES

- Identify an adequate measurement system

The importance of good data

Continuous:

- Measured on an infinitely divisible continuum
- Characterizes an output in terms of characteristics such as size, weight or time
- Examples
  - Time (hours, minutes, seconds, etc.)
  - Temperature (degrees, etc.)
  - Currency (dollars, yen, euros, etc.)

Source: The Six Sigma Way Team Fieldbook (2002)

The importance of good data

Discrete:

- Based upon frequency of occurrence
- Characterizes an output in terms of non overlapping categories
- Examples
  - Pass/Fail
  - Yes/ No
  - Win/Loss

Source: The Six Sigma Way Team Fieldbook (2002)

Compare & Contrast

Process	Continuous	Discrete
	Hold time per inbound call	Number of calls on hold past one minute
	Number of minutes to board a plan	Number of incidents of delayed boarding
	Individual student test scores	Number of students that failed the test

Pros & Cons of Each

Continuous

- Better data precision
- Don't need as large a sample size

- Not as easy to always interpret & understand
- Can be difficult to collect & insurance accuracy

Discrete

- Easier to interpret
- Easy to collect
- Straight-forward sigma calculation

- Not good data precision
- Need much larger sample sizes to identify patterns

Attributes of a good measurement system

- Accuracy – the differences between observed average measurement and a standard
- Repeatability – variation when one person repeatedly measures the same unit with the same measuring equipment
- Reproducibility – variation when two or more people measure the same unit with the same measuring equipment
- Stability – variation obtained when the same person measures the same unit with the same equipment over an extended period of time
- Linearity – the consistency of the measurement system across the entire range of the measurement system.

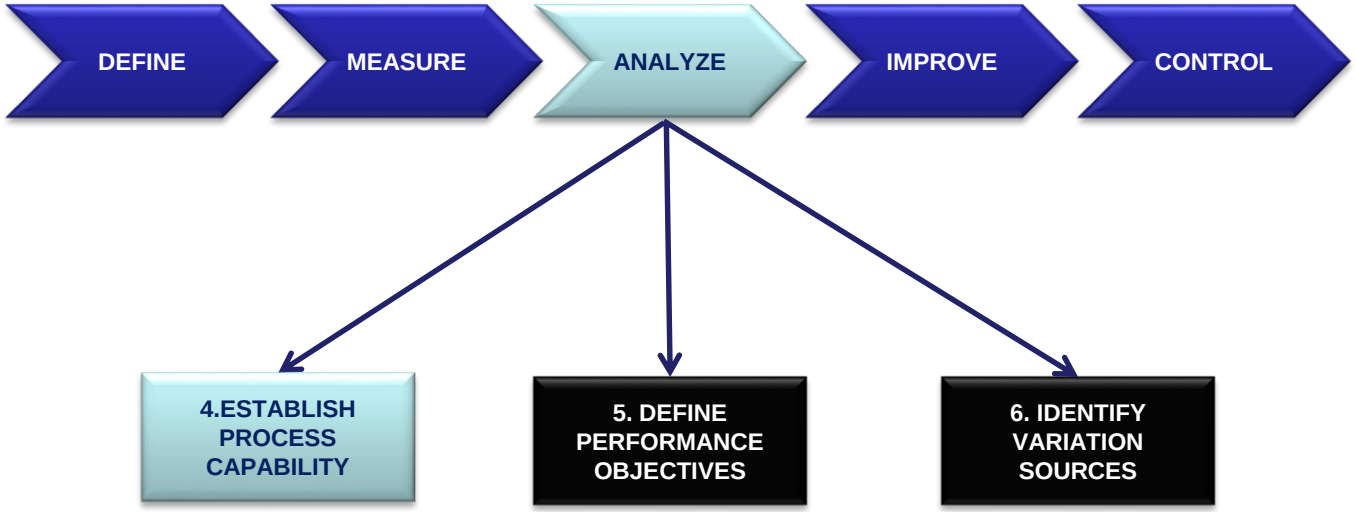
Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Think of it in terms of being on a firing range

- Accuracy – Do you hit the target where you aim?
- Repeatability – Can you hit the target in the same place every time?
- Reproducibility – Can another person using the same gun hit the target in the same place?
- Stability – If you come back a week later, can you shoot as accurately?
- Linearity – Are you as accurate at 300 ft. as you are at 100 ft. ?

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Step 4 Establish Process Capability

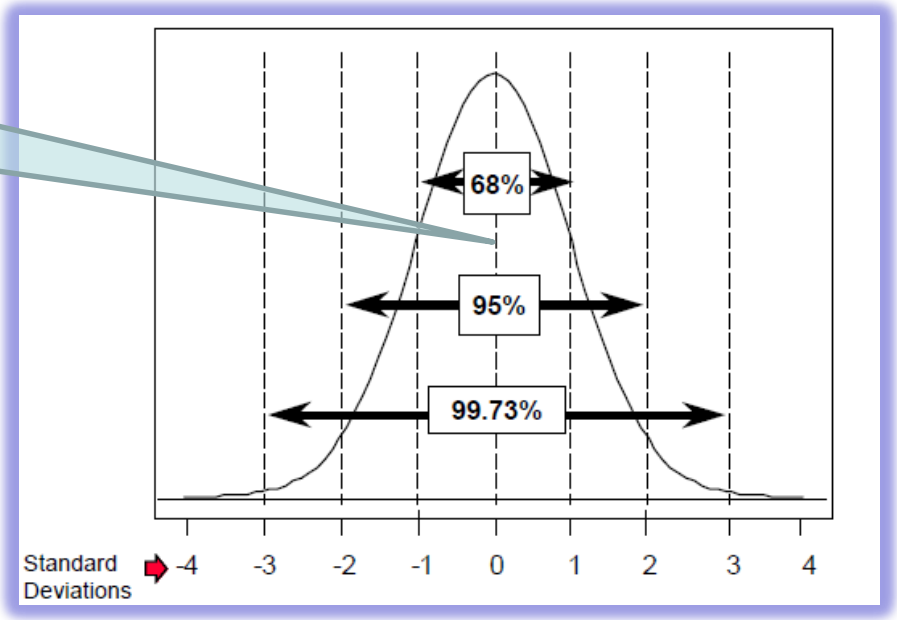


DELIVERABLES

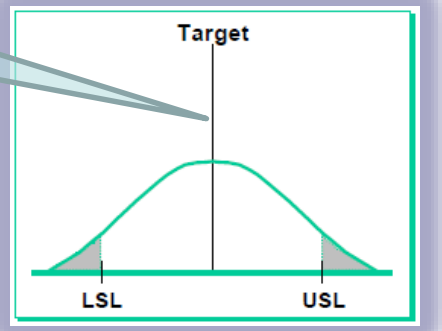
- Baseline the current process capability or "sigma"

The normal curve revisited

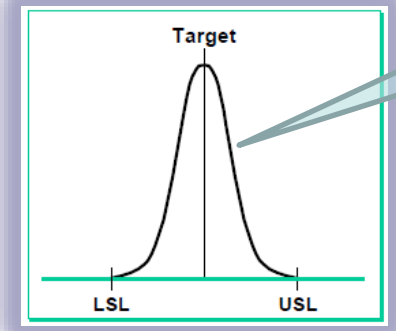
The "standard" normal distribution



Variation can be large…

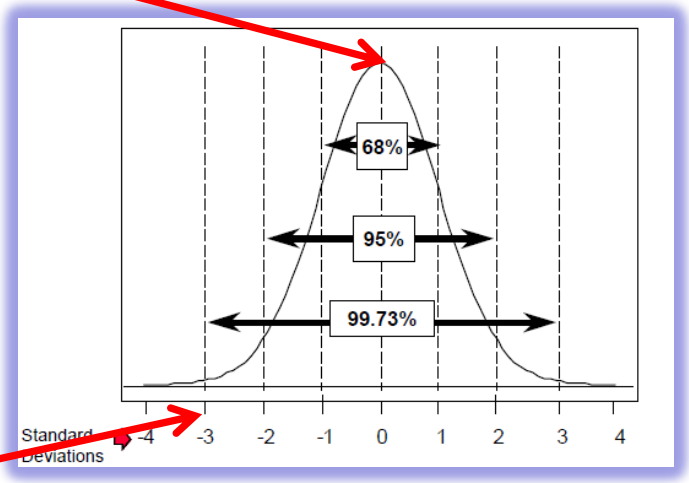


…or small



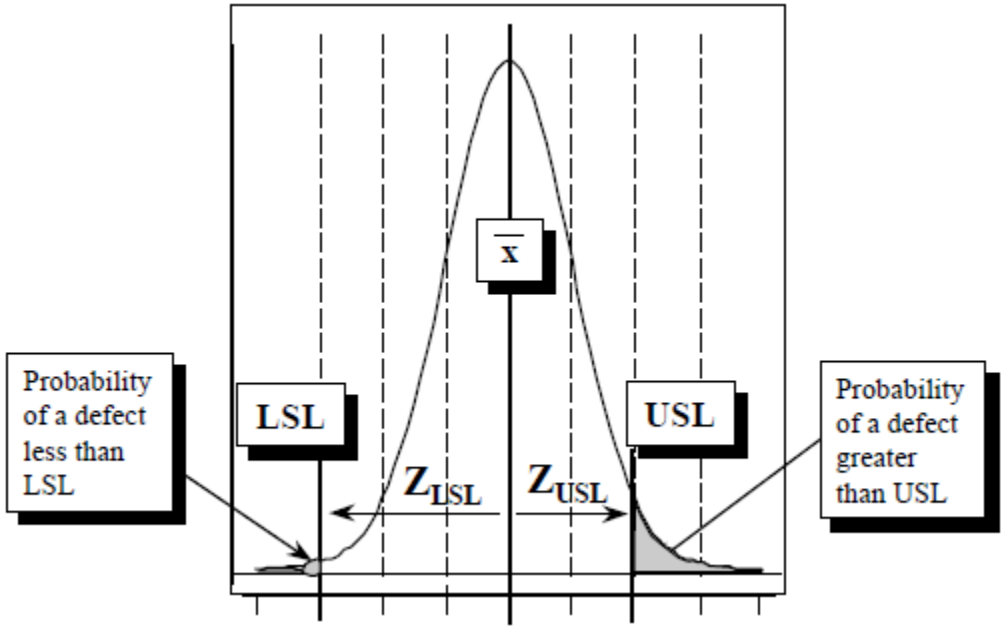
Some statistical terms to understand

μ (mu) – The measure of the "central tendency" in a population of data. Otherwise know as the mean or average. Classified as $\bar{x}$ for a sample of data.



σ (sigma) – The measure of the dispersion in a population of data. Classified as S for a sample of data.

Introducing the Z-value



Z-value - transforms any set of data in a normal distribution to the standard normal distribution with mean (mu) of 0 and standard deviation (sigma) of 1.

Allows the comparison of entirely different processes on a common scale -- standard deviation units.

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

A sample Z-value calculation

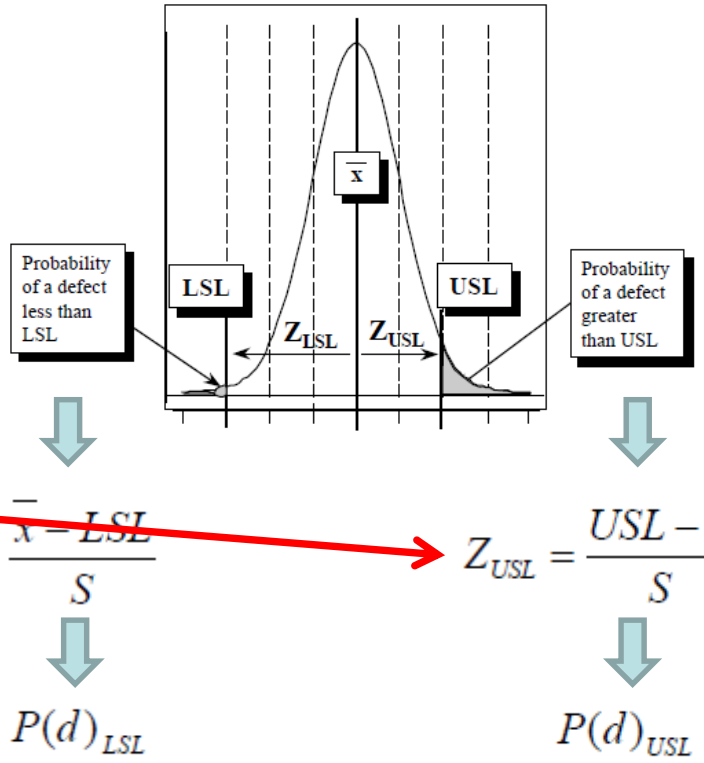
Example:

x (sample mean) = 30.2

S (sample std. dev.) = 1.2

USL = 33

LSL = 26



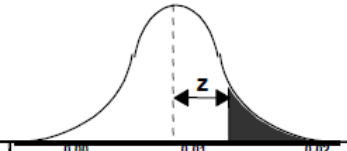
Z_{USL} = 2.33

Z_{LSL} = 3.50

Once the Z-values are calculated, consult a single tailed Z-table to find the probability of a defect or P(d) -- i.e how likely will a value exceed the spec limit.

The single-tailed Z-table

Single Tail Z-Table
(Values of z from 0.00 to 3.99)



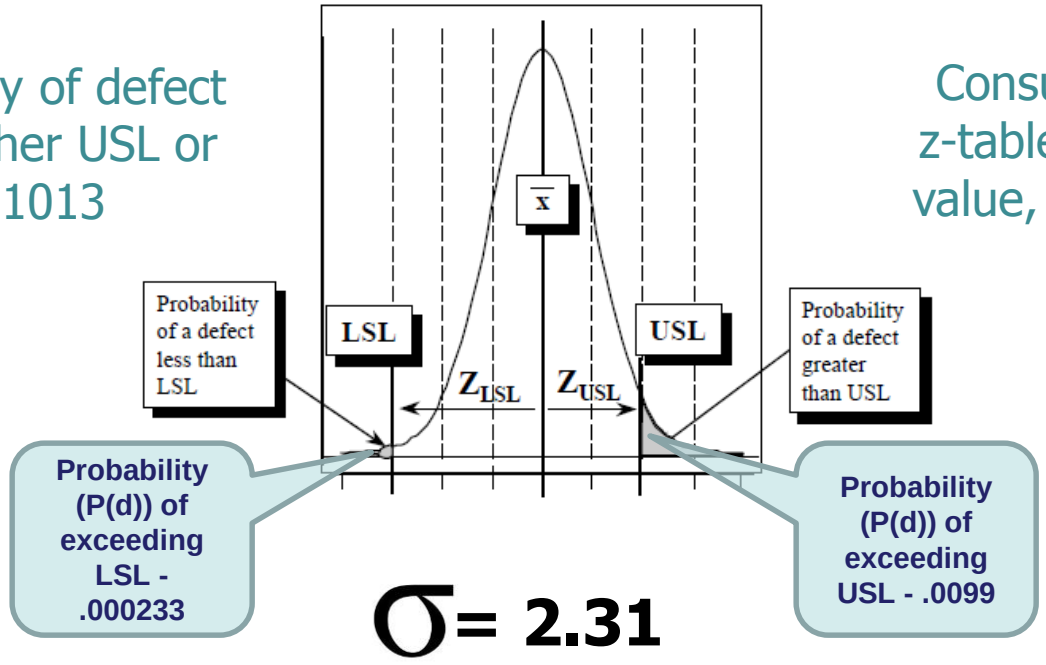
Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.10	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.20	.4607	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.30	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.40	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.50	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.60	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.70	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.80	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.90	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.00	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.10	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.20	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.30	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.40	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.50	.0668	.0655	.0643	.0630	.0618	.0606	0594	.0582	.0571	.0559
1.60	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.70	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.80	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.90	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.00	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.10	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.20	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.00116	.0113	.0110
2.30	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.40	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.50	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00509	.00494	.00480
2.60	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
2.70	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
2.80	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.90	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00104	.00139
3.00	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00144	.00100
3.10	.000968	.000936	.000904	.000874	.000845	.000816	.000789	.000762	.000736	.000711
3.20	.000687	.000664	.000641	.000619	.000598	.000577	.000538	.000538	.000519	.000501
3.30	.000483	.000467	.000450	.000434	.000419	.000404	.000376	.000376	.000362	.000350
3.40	.000337	.000325	.000313	.000302	.000291	.000280	.000260	.000260	.000251	.000242
3.50	.000233	.000224	.000216	.000208	.000200	.000193	.000179	.000179	.000172	.000165
3.60	.000159	.000153	.000147	.000142	.000136	.000131	.000121	.000121	.000112	.000112
3.70	1.08E-4	1.04E-4	9.96E-5	9.58E-5	9.20E-5	8.84E-5	8.16E-5	8.18E-5	7.8E-5	7.53E-5
3.80	7.24E-5	6.95E-5	6.67E-5	6.41E-5	6.15E-5	5.91E-5	5.44E-5	5.46E-5	5.22E-5	5.01E-5
3.90	4.81E-5	4.62E-5	4.43E-5	4.25E-5	4.08E-5	3.91E-5	3.60E-05	3.61E-5	3.45E-5	3.31E-5

Area under the normal curve past the Lower Spec Limit (LSL)

Area under the normal curve past the Upper Spec Limit (USL)

Calculate the total Z-value (sigma)

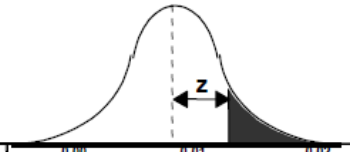
Total probability of defect (exceeding either USL or LSL) is .01013



Consult the single-tail z-table to get a total Z-value, or sigma, of 2.31

Back to the single-tailed Z-table

Single Tail Z-Table
(Values of z from 0.00 to 3.99)



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.10	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.20	.4607	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.30	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.40	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.50	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.60	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.70	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.80	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.90	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.00	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.10	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.20	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.30	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.40	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.50	.0668	.0655	.0643	.0630	.0618	.0606	0594	.0582	.0571	.0559
1.60	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.70	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.80	.0359	.0351	.0344	[illegible]	.0329	.0322	.0314	.0307	.0301	.0294
1.90	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.00	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.10	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.20	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.00116	.0113	.0110
2.30	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.40	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.50	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00509	.00494	.00480
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2.80	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.90	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00104	.00139
3.00	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00144	.00100
3.10	.000968	.000936	.000904	.000874	.000845	.000816	.000789	.000762	.000736	.000711
3.20	.000687	.000664	.000641	.000619	.000598	.000577	.000538	.000538	.000519	.000501
3.30	.000483	.000467	.000450	.000434	.000419	.000404	.000376	.000376	.000362	.000350
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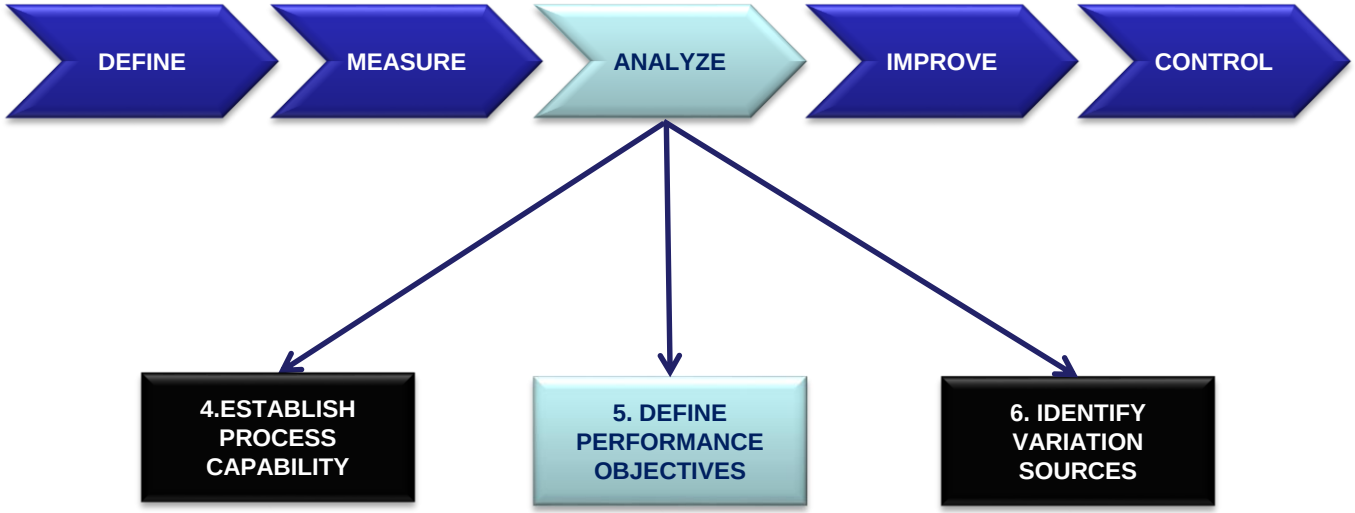
3.50	.000233	.000224	.000216	.000208	.000200	.000193	.000179	.000179	.000172	.000165
3.60	.000159	.000153	.000147	.000142	.000136	.000131	.000121	.000121	.000112	.000112
3.70	1.08E-4	1.04E-4	9.96E-5	9.58E-5	9.20E-5	8.84E-5	8.16E-5	8.18E-5	7.8E-5	7.53E-5
3.80	7.24E-5	6.95E-5	6.67E-5	6.41E-5	6.15E-5	5.91E-5	5.44E-5	5.46E-5	5.22E-5	5.01E-5
3.90	4.81E-5	4.62E-5	4.43E-5	4.25E-5	4.08E-5	3.91E-5	3.60E-05	3.61E-5	3.45E-5	3.31E-5

Find the total area, translate it back to a sigma (Z) score

Step 5 Define Performance Objectives



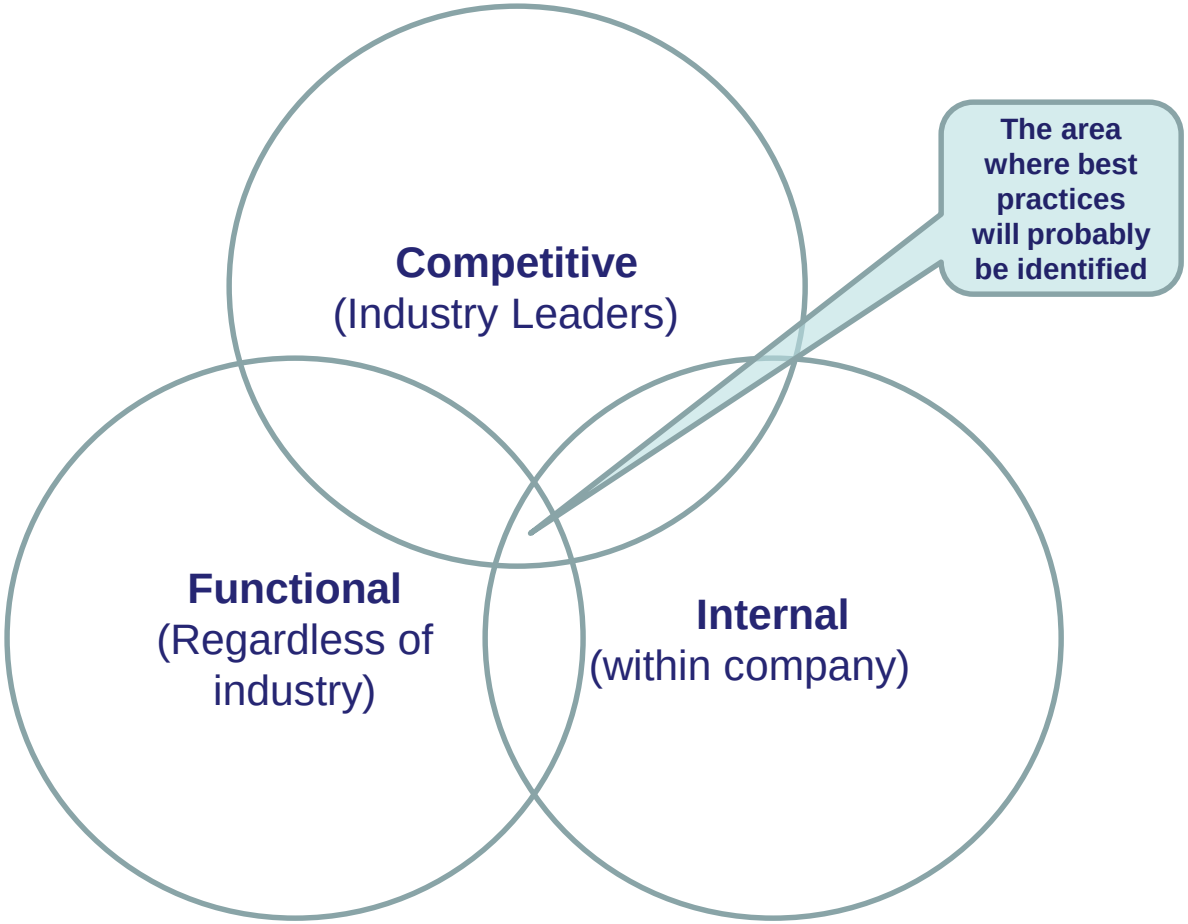
DELIVERABLES

- Define the goal of the project

Benchmarking

Benchmarking is the process of continually searching for the best methods, practices and processes, and either adopting or adapting their good features and implementing them to become the "best of the best"

Sources for benchmarking



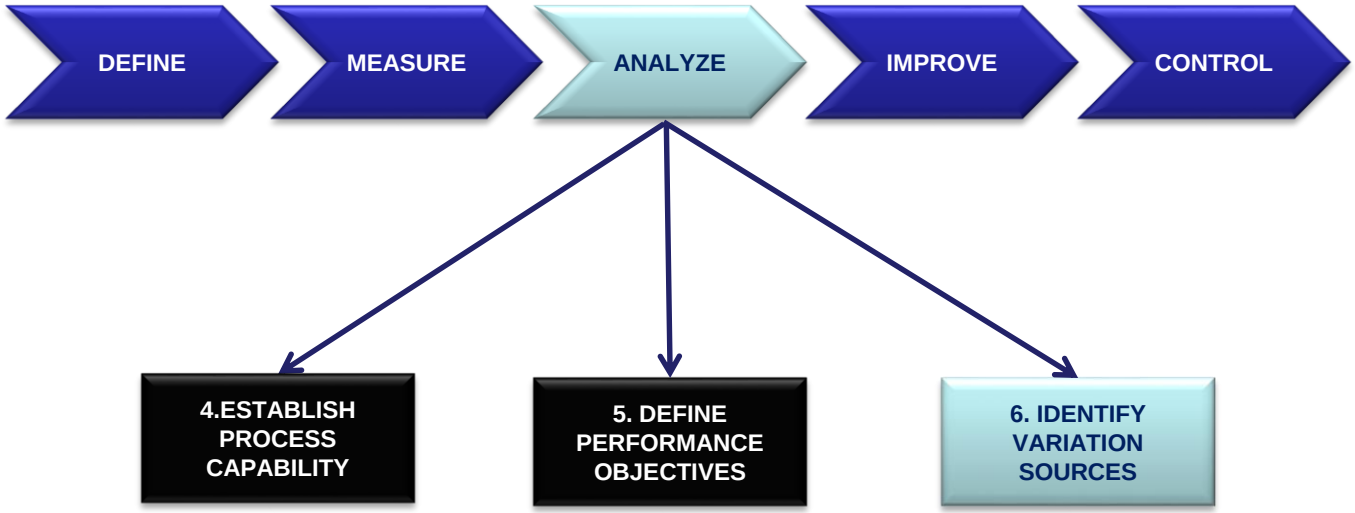
Objectives of Benchmarking

End objective – Become the very best at what you do and seek continuous improvement.

Benchmarking:

- Is a means of identifying best practices
- Helps locate new techniques and technologies used by processes that perform as "best in class"
- Is a continuous process for measuring outputs against comparable practices from external and internal sources.
- Draws upon the integration of data collection, practices and execution into the decision-making process for improvement

Step 6 Identify Variation Sources



DELIVERABLES

- Identify the X's (process inputs) that affect the Y (outputs)

The mathematical nature of process

$$y = f(x_1 \ldots . x_n)$$

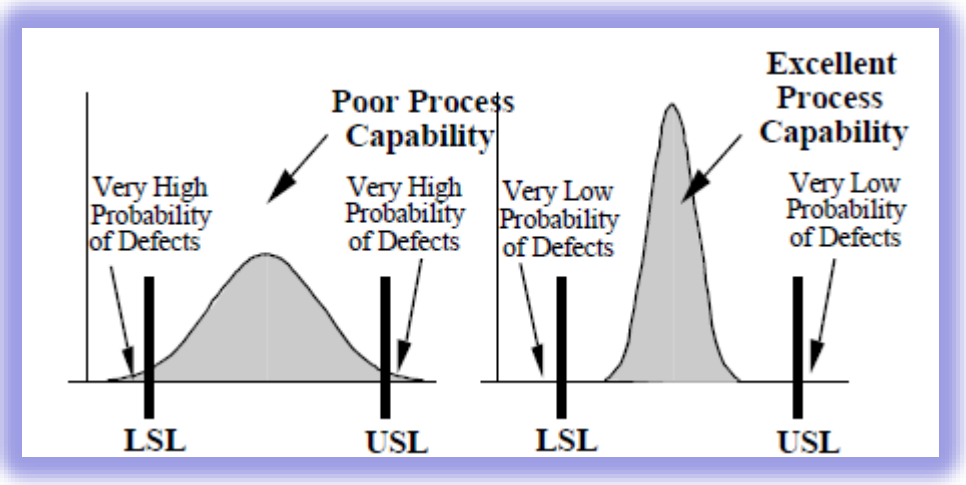
Simply put: A process (y) is a function of many inputs (x's)

"Y"	"$x_1 \ldots . x_n$"
Dependent Variable	Independent Variable
Process Output	Process Input
Effect	Cause
Symptom	Problem
Monitor	Control

Step 6 is all about using tools to identify what may be causing variation in a process.

The objective: less variation more capability

Move from more to less variation



Move from lower capability (sigma) to higher capability

Tools to identify variation

Great Six Sigma Tools for identifying variation:

- Process Map – Understand the steps in the process in a visual fashion
- FMEA (Failure Modes Effect Analysis) – A systematic approach to identifying risks and mitigation/avoidance strategies
- Cause & Effect (Fishbone) Diagram – Attain better understanding of problem through thorough analysis of possible causes
- Pareto Chart – Separate the vital few from the trivial many causes for variation.

Failure Modes Effect Analysis

Risk Severity(1-not very, 10 – disastrous)

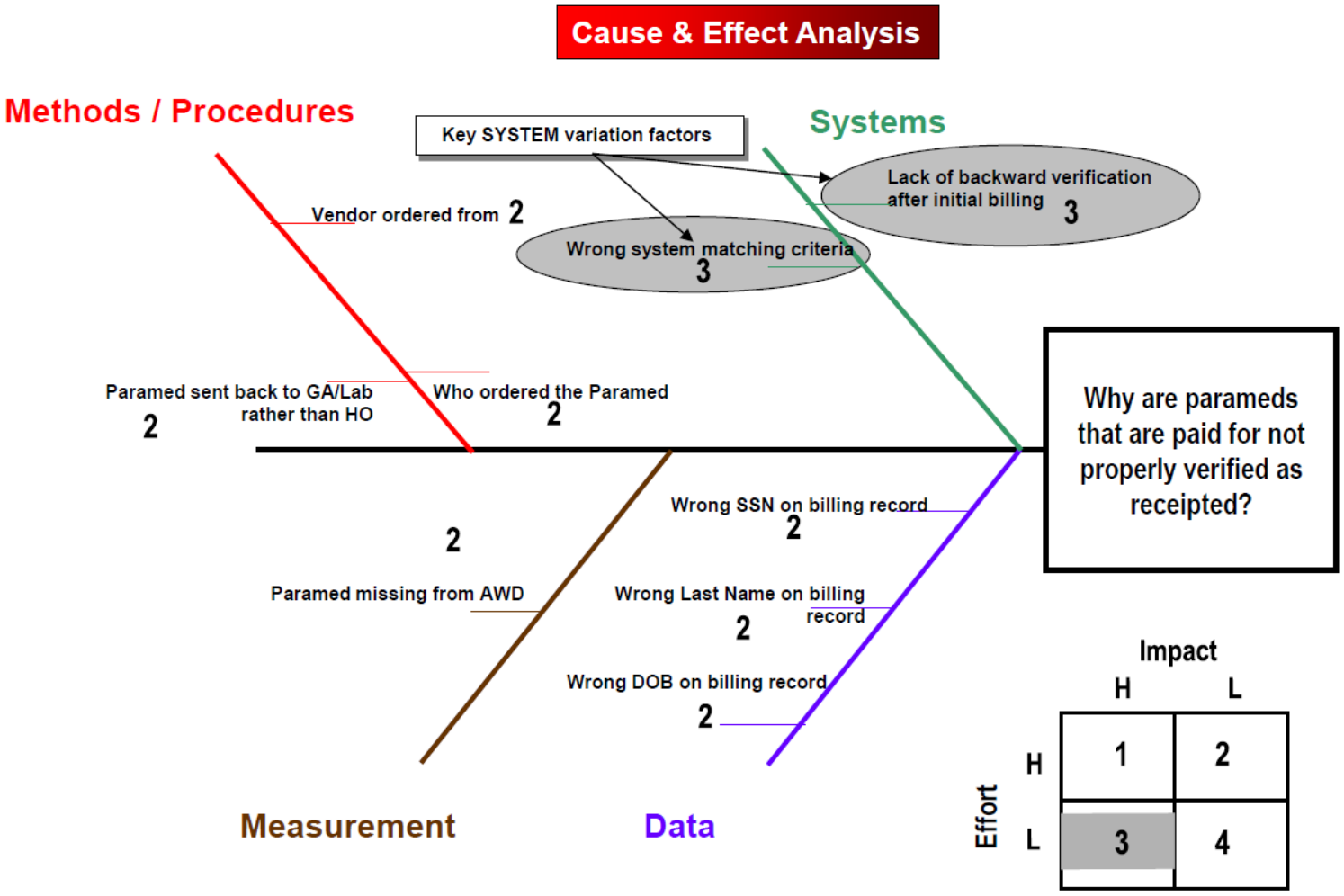
Probability of happening (1-highly unlikely, 10 – highly likely)

Likelihood of detection (1-highly likely, 10 – highly unlikely)

RPN – Risk Priority Number (S*P*D)

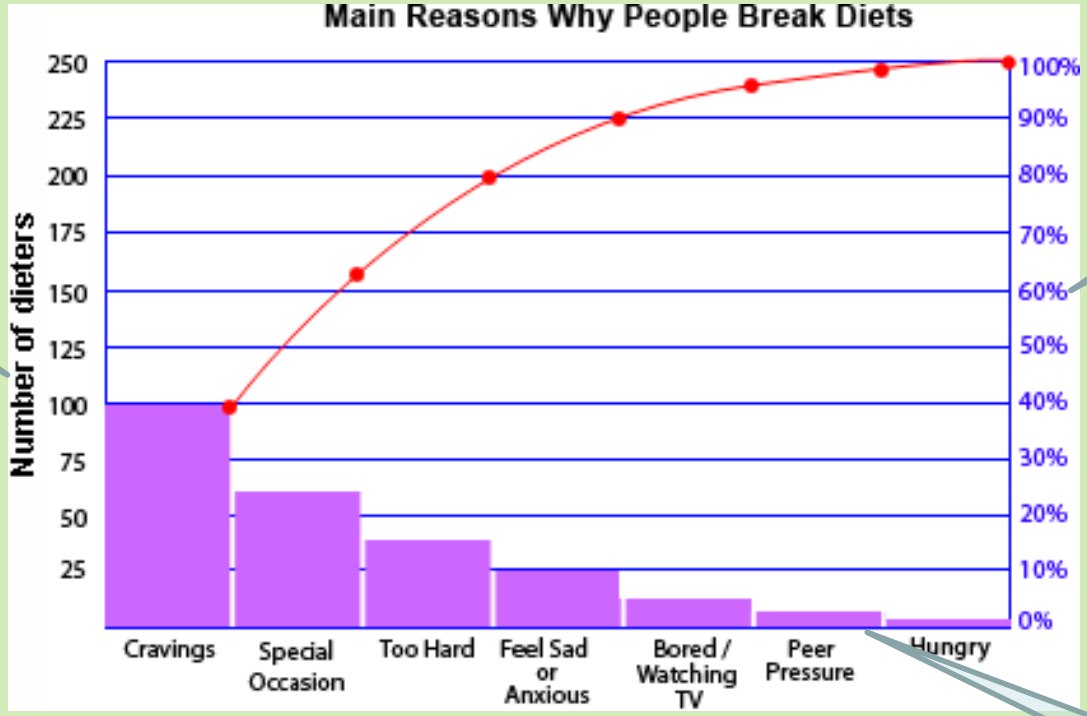
Item/Function	Potential Failure Modes	Potential Effects of Failure	SEV	Potential Causes of Failure	PROB	Current Design Controls	DET	RPN	Recommended Actions	Target Date and Responsibility	Action Results				
											Actions Taken	New SEV	New PROB	New DET	New RPN
Nomenclature /worktype xref not properly coded	ImageCop Worktype not properly identified for billing nomenclature	Billing not properly matched to receipted data	10	Oversight of billing nomenclature as valid ImageCop worktype	4	None	5	200	Periodically review nomenclatures for proper cross-reference to worktype	Phil Hamlett (6/1/2004)	Nomenclatures scanned for cross-reference completeness	10	2	5	100
No means of examining backward verification information for paramed receipt	No reporting mechanism present to report on new status	No way to verify that paramed was received within 60 days of invoice	8	BO reports not properly updated with new status information	10	None	1	80	Provide BO detail report to review 60-day status	Phil Hamlett (6/302004)	RFS #060200017 submitted to IT to provide new reporting	8	1	1	8
All paramed imaging not present in ImageCop	No feed present from AWD to Image Cop for all parameds imaged at ICC	Billing not properly matched to receipted data	10	ImageCop has no automated method to get all image data from AWD	10	None	9	900	Request automated AWD image data feed from GENIUS	Phil Hamlett (7/312004)	GENIUS bug #5794 submitted to IT to provide AWD data feed	10	2	9	180

Cause & Effect Diagram



Also known as Fishbone or Ishikawa Diagram

The Pareto Chart



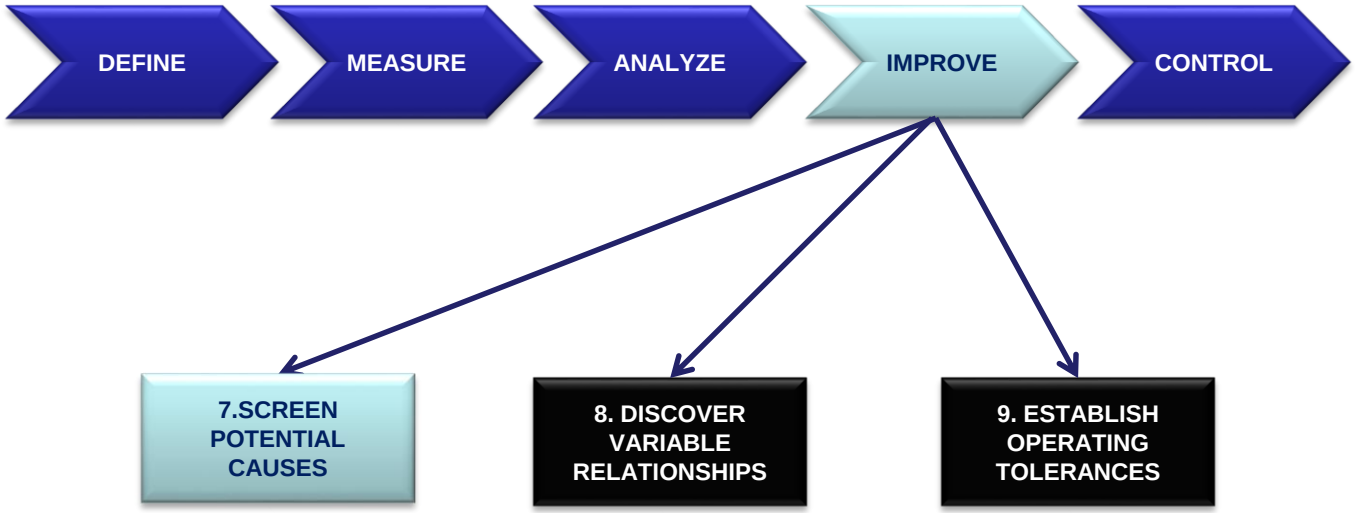
Absolute values

Cumulative percentage

Area causing the issue or 'defect'

...identifies key areas that cause an issue

Step 7 Screen potential causes



DELIVERABLES

- Determine the "vital" inputs (X's) that are affecting the output (Y)

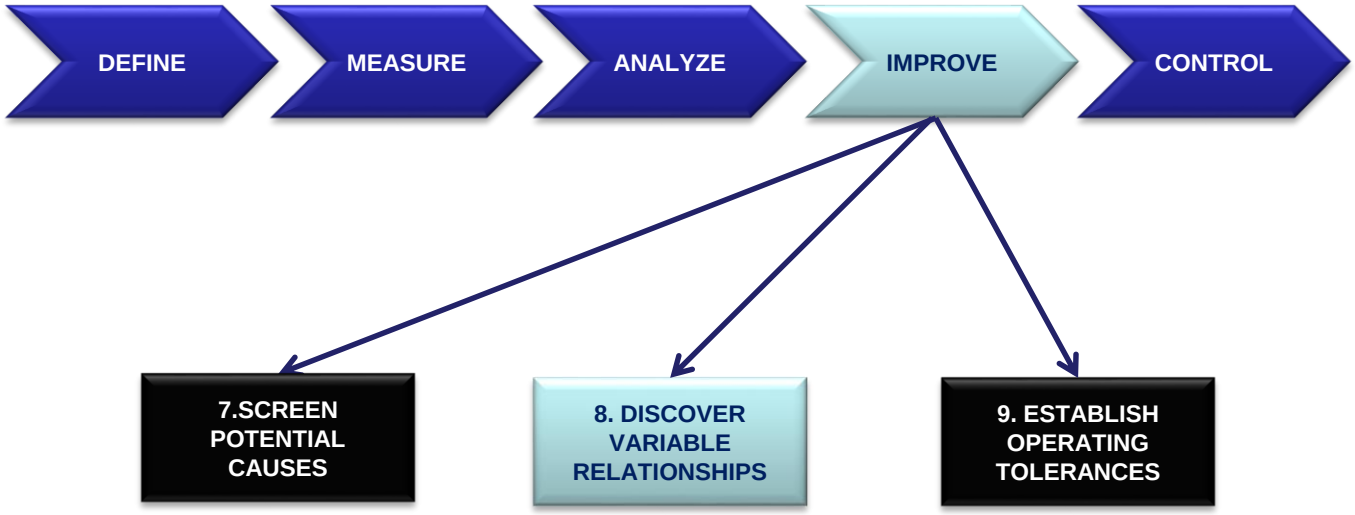
objectives of Step 7

$$y = f(x_1 \ldots . x_n)$$

Key Deliverables:

- Identify all "Xs" (independent variables,root causes)
- Isolate the "vital few Xs"
- Prove statistically that each one is a "vital X"
- Quantify the magnitude of the impact of each X
- Develop improvement plan (what to do about each X to attain project goals)
- Implement findings to improve the process

Step 8 Discover variable relationships



DELIVERABLES

- Establish the "transfer function" between the x's and Y (build the process)
- Pilot the solution

Identify Possible solutions

Attach a weight (importance) to each selection criteria)

Score each choice as to how well it meets the criteria

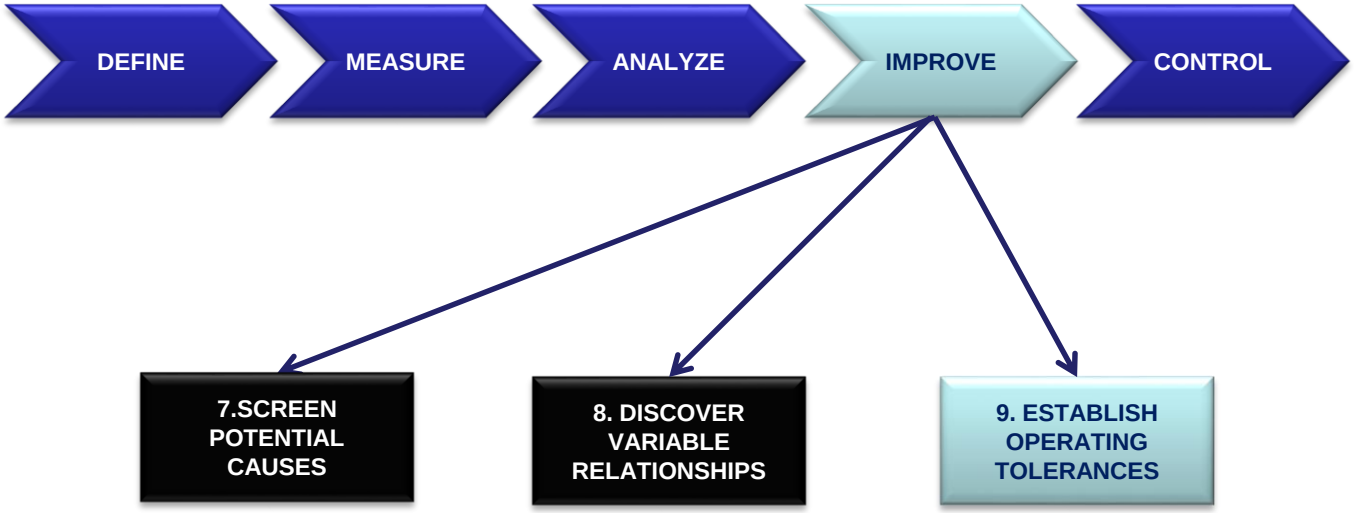
		Data Variation				System Variation			
		Fix SSN data		Fix Last Name Data		Implement backward verification		Fix nomenclature matching	
Solution Selection Criteria	**Weight**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**
Likelihood of verification	10	10	100	9	90	9	90	9	90
Ease of Implementation	8	1	8	1	8	10	80	8	64
Immediate process impact	7	2	14	2	14	7	49	10	70
Total			**122**		**112**		**219**		**224**

* Score = Solution's ability to address selection criteria (1 is low and 10 is high)

Obtain a weighted score for each solution

...the weighted scoring model or Pugh matrix

Step 9 Establish Operating Tolerances



DELIVERABLES

- Specify tolerances on the x's and how they will operate

A number of ways to check your data

Normal Data	Non-normal Data
Variance Tests χ^2 - Compares a sample variance to a known population variance. **F-test-** Compares two sample variances. **Homogeneity of Variance** **Bartlett's -** Compares two or more sample variances **Means Tests** **t-Test 1-sample -**Tests if sample mean is equal to a known mean or target. **t-Test 2-sample -**Tests if two sample means are equal. **ANOVA One Way -** Tests if two or more sample means are equal. **ANOVA Two Way-** Tests if means from samples classified by two categories are equal. **Correlation-** Tests linear relationship between two variables. **Regression** - Defines the linear relationship between a dependent and independent variable. (Here, "Normality" applies to the residuals of the regression	**Variance Tests** **Homogeneity of Variance** **Levine's-** Compares two or more sample variances. **Medians Tests** **Mood's Median Test-** Another test for two or more medians. More robust to outliers in data. **Correlation-**Tests linear relationship between two variables.

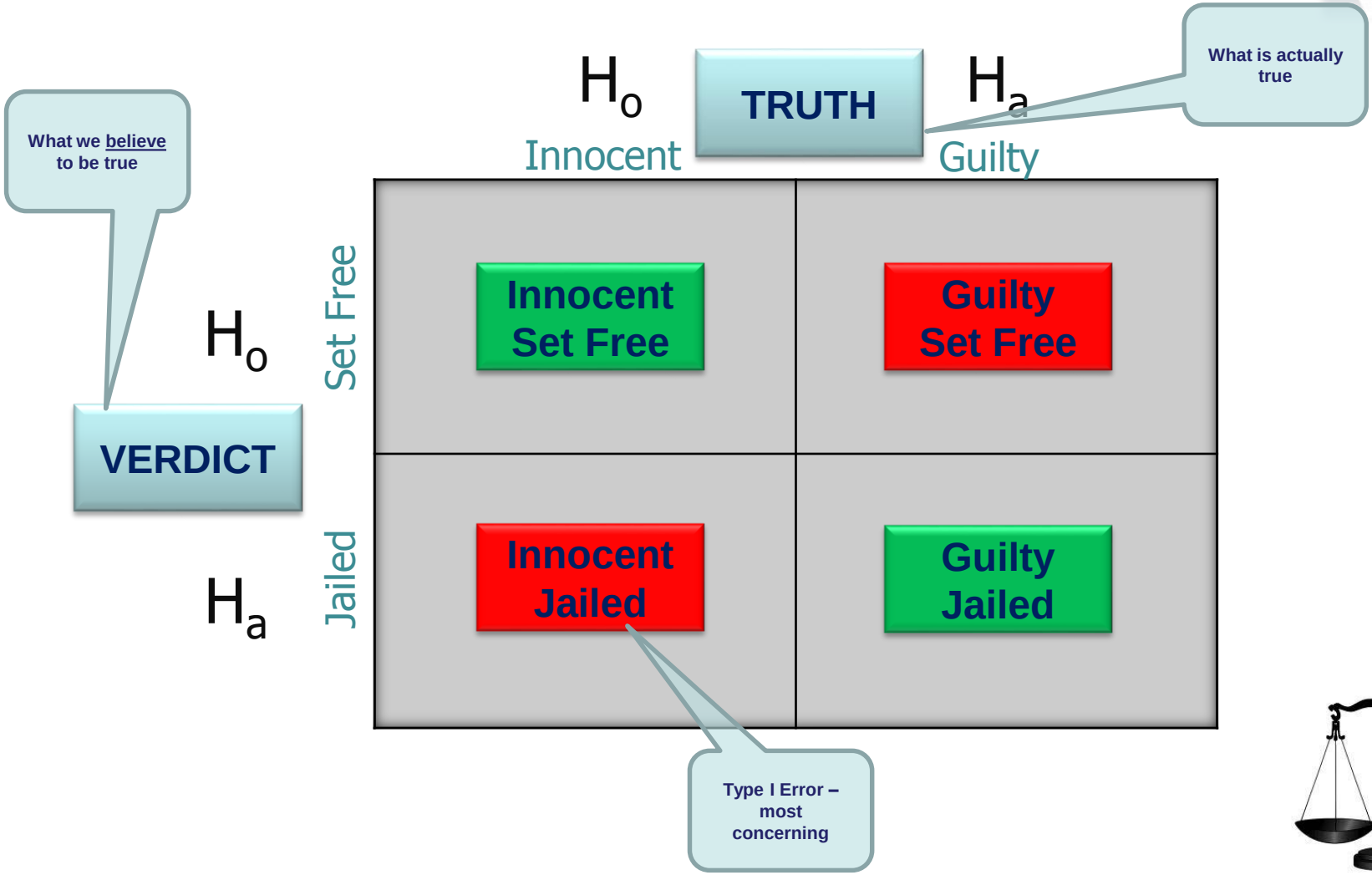
Hypothesis Testing

To understand how it works lets use our justice system….

By default, innocence is assumed until guilt is proven.

To put it in statistical terms, the null hypothesis (H_o) is that the defendant is innocent, the alternate hypothesis (H_a) is that the defendant is guilty.

Coming to a decision



Alpha defined

To account for the possibility of a Type I error, statistics uses the concept of significance level (the "reasonable doubt")- that level at which it is believed that differences in data no longer due to random chance, but rather to cause.

Significance level is denoted by alpha (α)

Most common alpha is .05 -- i.e. no more than a 5% chance of being wrong.

A higher or lower one may be used depending on the amount of risk to be undertaken for being potentially wrong..

Reject or Accept

Statistical tests will generate a P-value.

To test the hypothesis, compare the P-value to alpha (α)

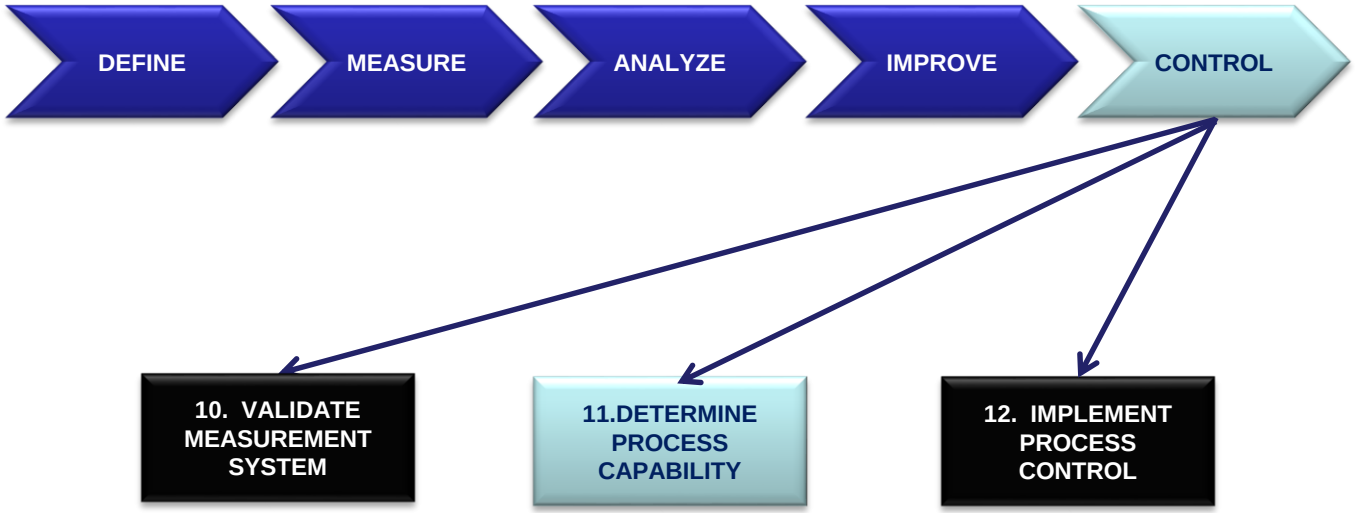
P-value > α

- Accept the null (H_o)
- Reject the alternate (H_a)

P-value < α

- Reject the null (H_o)
- Accept the alternate (H_a)

Step 11 Determine Process Capability



DELIVERABLES

- Determine post-improvement capability and performance

Compare before and after

Before & After Performance Assessment

	$Sigma_{ST}$	# Defects	# Opportunities	DPMO	Yield
Baseline Performance	2.05	2,772	9,751	284,278	71.5%
Project Improvement	2.847	867	9,751	88,914	90.1%

$Z_{st} = 2.847$

DPMO Method

- UNITS – 1 paramed per billing
- OPPORTUNITIES – 9,751 billings
- DEFECTS – 867 unverified parameds
- DPO - .0088
- DPMO – 88,914
- BASELINE Z_{st} = 2.847

DPMO method used here to calculate sigma because of discrete data

Report 7: Product Performance

Characteristic	Defx	Units	Opps	TotOpps	DPU	DPO	PPM	ZShift	ZBench
1	867	1	9751	9751	867.000	0.088914	88914	1.500	2.847
Total	867			9751		0.088914	88914	1.500	2.847

DPMO –How does it work?

1. Number of Units processed — N = _____
2. Number of Defect Opportunities Per Unit — O = _____
3. Total number of Defects made (include defects made and later fixed) — D = _____

4. Solve for Defects Per Opportunity

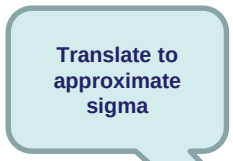
$$DPO = \frac{D}{N \cdot O} = \frac{(\quad)}{(\quad)(\quad)} = \_\_\_\_\_$$

5. Convert DPO to DPMO

$$DPMO = DPO \cdot 1{,}000{,}000 = \_\_\_\_\_ \cdot 1{,}000{,}000 = \_\_\_\_\_$$

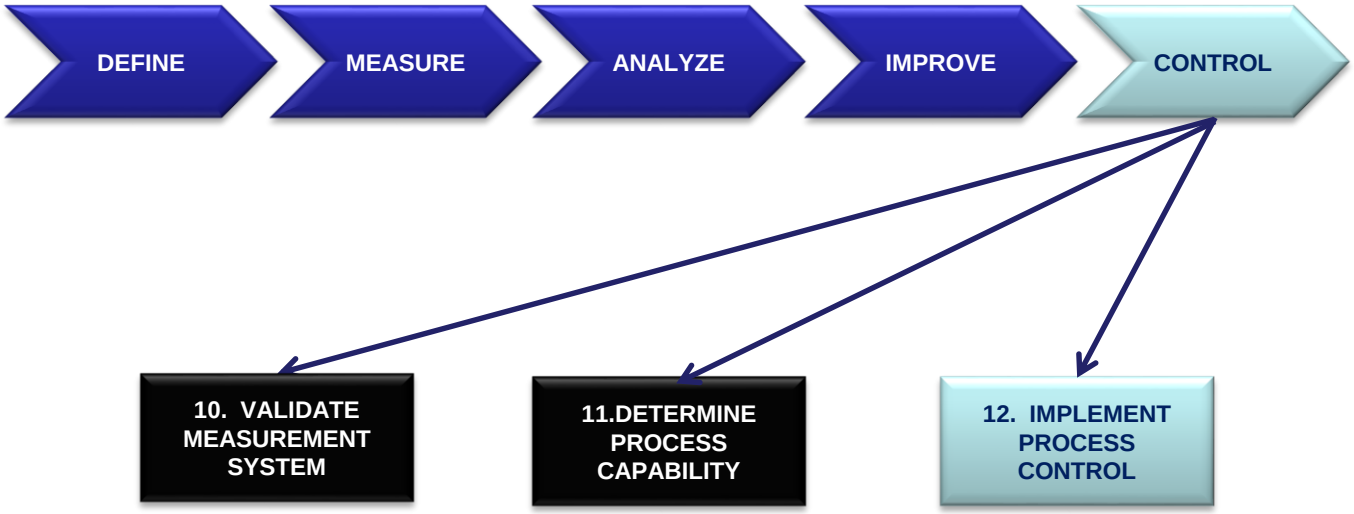
Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Sigma Conversion Table



Long-Term Yield	Process Sigma (ST)	Defects Per 1,000,000	Defects Per 100,000	Defects Per 10,000	Defects Per 1,000	Defects Per 100
99.99966%	6.0	3.4	0.34	0.034	0.0034	0.00034
99.9995%	5.9	5	0.5	0.05	0.005	0.0005
99.9992%	5.8	8	0.8	0.08	0.008	0.0008
99.9990%	5.7	10	1	0.1	0.01	0.001
99.9980%	5.6	20	2	0.2	0.02	0.002
99.9970%	5.5	30	3	0.3	0.03	0.003
●						
●						
●						
97.730%	3.5	22,700	2,270	227	22.7	2.27
97.130%	3.4	28,700	2,870	287	28.7	2.87
96.410%	3.3	35,900	3,590	359	35.9	3.59
95.540%	3.2	44,600	4,460	446	44.6	4.46
94.520%	3.1	54,800	5,480	548	54.8	5.48
93.320%	3.0	66,800	6,680	668	66.8	6.68
91.920%	2.9	80,800	8,080	808	80.8	8.08
90.320%	2.8	96,800	9,680	968	96.8	9.68
88.50%	2.7	115,000	11,500	1,150	115	11.5
86.50%	2.6	135,000	13,500	1,350	135	13.5

Step 12 Implement Process Control



DELIVERABLES

- Develop and implement process control plan
- Monitor Quality

Controlling the process

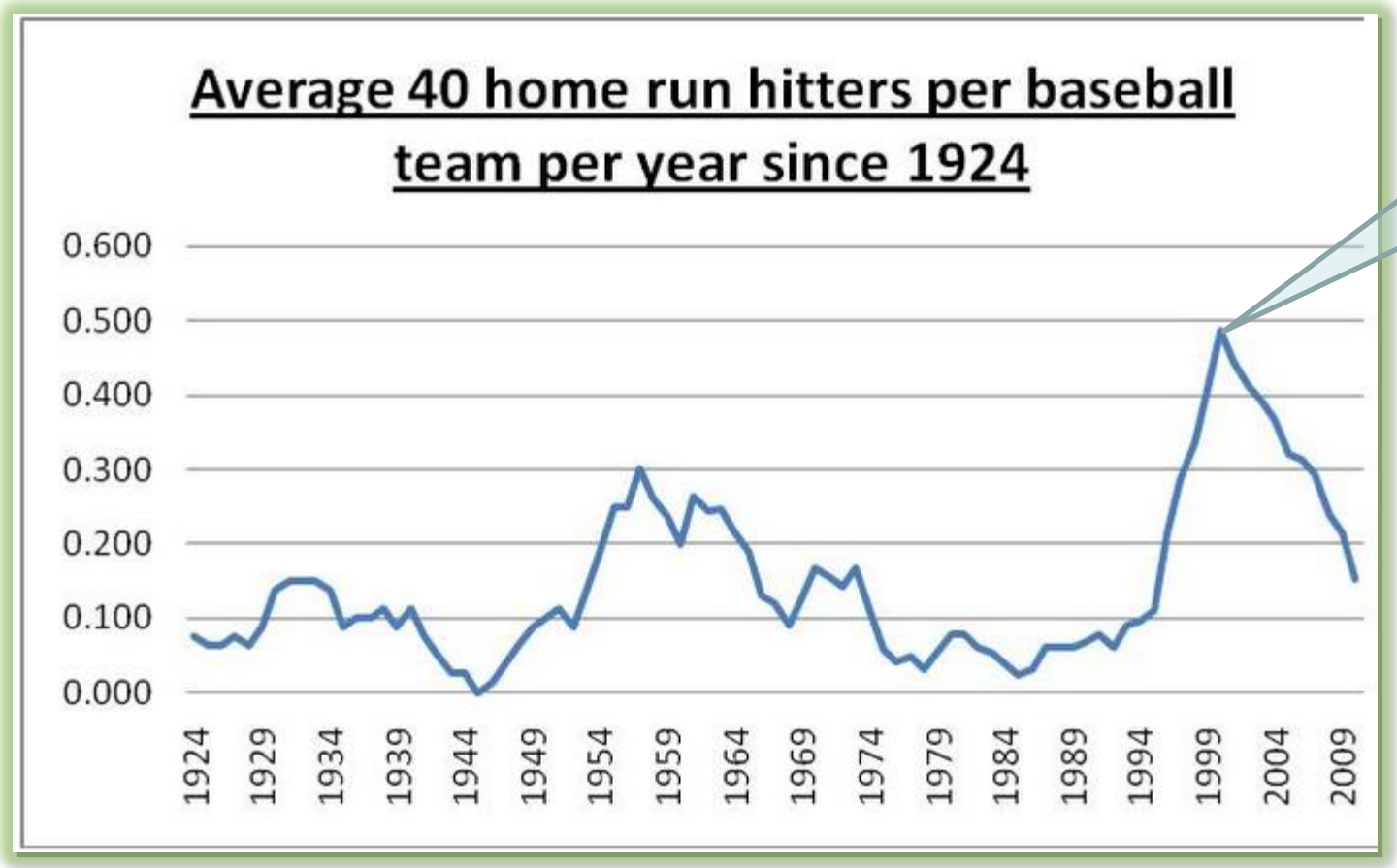
Key questions when approaching this phase…

- Why monitor?
- What should I monitor?
- How much data do I collect?
- How can I detect changes in process variation or capability?
- What do I do if I detect a change?
- If the process is in control and capable, are my customers still satisfied?

Source: General Electric Six Sigma Book of Knowledge (version 1.3)

Run Chart

...displays the history and pattern of variation of a process over time



Key Takeaways

Key Takeaways

- Six Sigma is geared around identifying sources of variation in a process, and then eliminating those sources thereby enhancing process capability.
- Sigma is a measure of the distribution (spread) about the mean (average) of any process.
- Understand your customer and what their needs are (CTQ's). Strive first to get their input (VOC)
- A process can be viewed as a mathematical function, where a series of input x's produce an output – Y.

Key Takeaways

- A signed-off charter gives the Six Sigma professional at least the implicit authority to do the work of improving/creating the process.
- Installation of a good measurement system begins with the articulation of clear operational definitions.
- Understand the key differences between continuous and discrete data and how to recognize each.
- Benchmarking helps you become the very best at what you do while always seeking continuous improvement

Epilogue
Question/Answer/Comments

Introduction to Project Management

The Road Map

- Project, Program & Portfolio Management – a primer
- Accountability vs. Authority
- Project and Project Management defined
- Project Management Process Groups & Knowledge Areas
  - Initiation
  - Planning
  - Execution
  - Monitor & Control
  - Closing
- Epilogue, Question & Answer Session

Project, Program & Portfolio Management

Why does project management matter?

- Many organizations today have a new or renewed interest in project management
  - In 2007 the total compensation for the average senior project manager in U.S. dollars was $104,776 per year in the U.S., $111,412 in Australia, and $120,364 in the U.K.
  - Project management certification is popular worldwide
  - The U.S. spends $2.3 trillion on projects every year, or one-quarter of its gross domestic product, and the world as a whole spends nearly $10 trillion of its $40.7 gross product on projects of all kinds

Source: Schwalbe, Information Technology Project Management, Sixth Edition, 2010

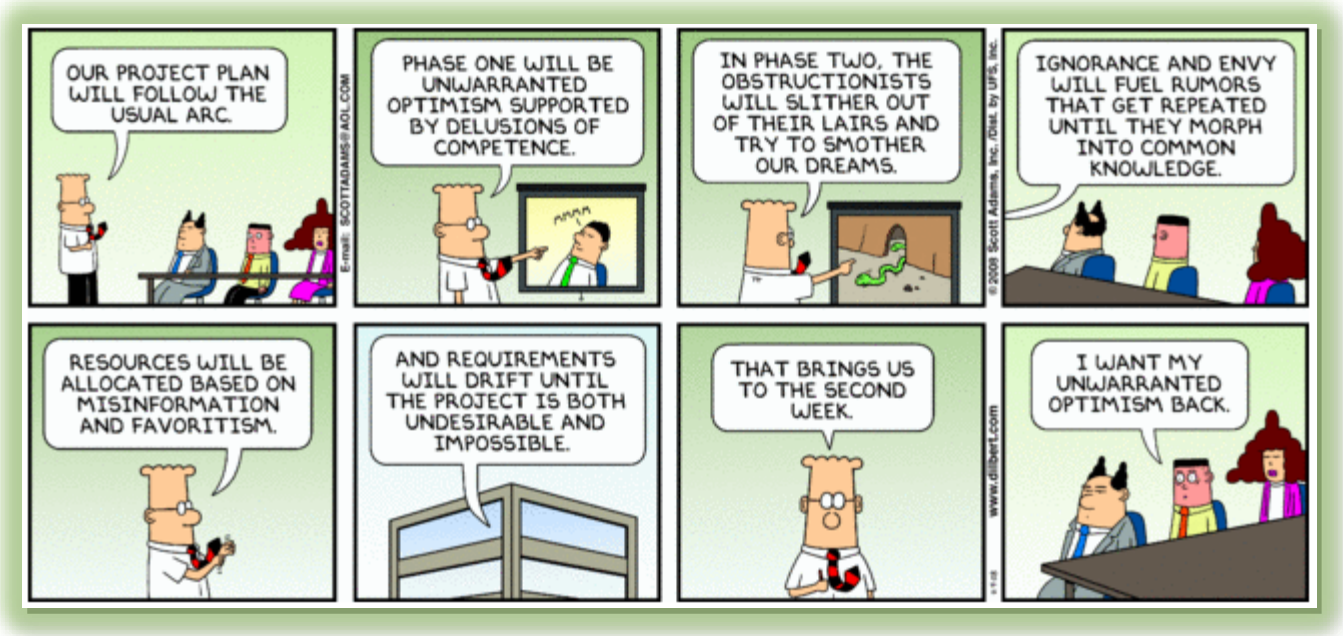
Why does project management matter?

- Effective project management methods in business typically lead to:
  - Better control of financial, physical, and human resources
  - Improved customer relations
  - Shorter development times
  - Lower costs
  - Higher quality and increased reliability
  - Higher profit margins
  - Improved productivity
  - Better internal coordination
  - Higher worker morale

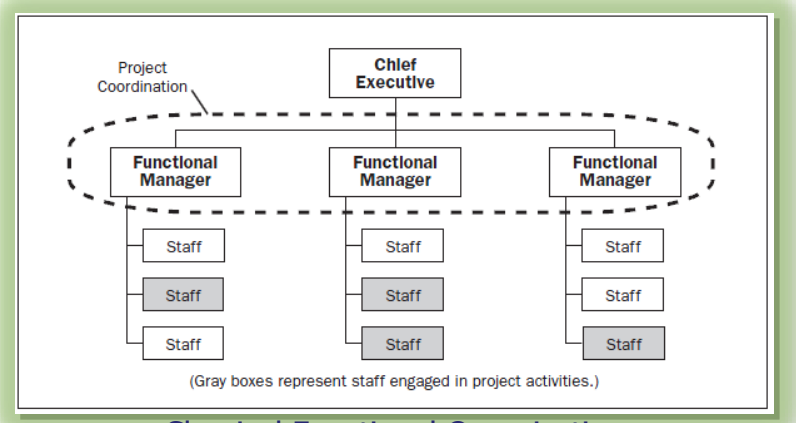
Accountability vs. Authority

"Project Managers are given all kinds of accountability for projects, yet no authority with which to complete them."

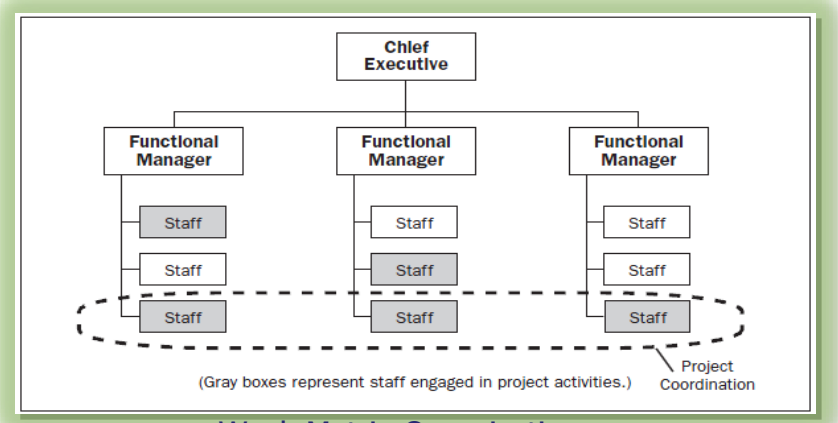
Source: Phil Hamlett (circa 2012)



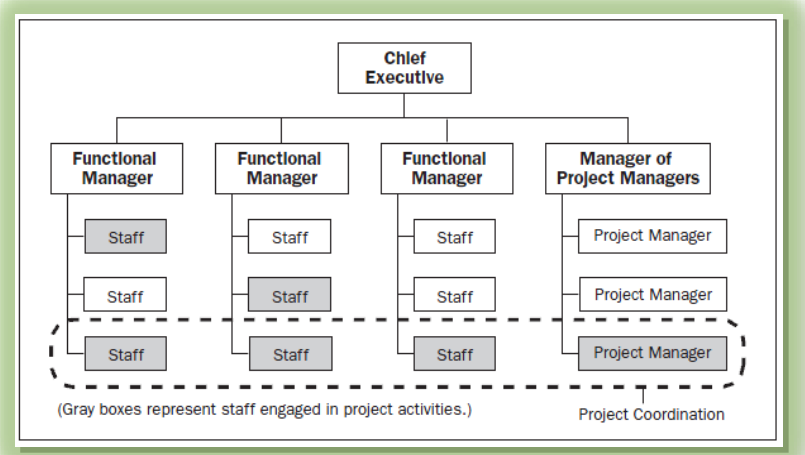
What does authority mean?



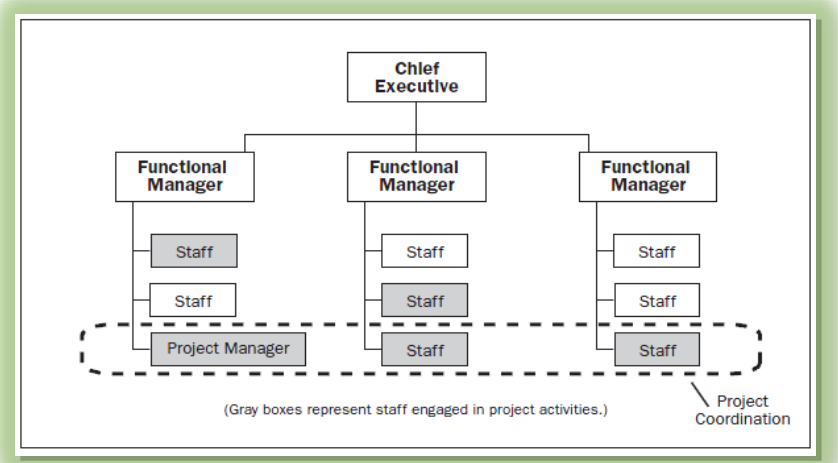
Classical Functional Organization



Weak Matrix Organization



Strong Matrix Organization



Balanced Matrix Organization

Source: PMBOK Guide 4th Edition - PMI

Which environment is best?

Organization Structure / Project Characteristics	Functional	Matrix			Projectized
		Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

If you are a career project manager, you are loving life in a strong matrix or projectized organization, everywhere else, not so much.

Project defined

A **project** is "a temporary endeavor undertaken to create a unique product, service, or result"*

Source: PMBOK Guide 4th Edition - PMI

Projects come to closure when the objective has been achieved, or the project has been terminated, for whatever reason.

Project Attributes

A project:

- Has a unique purpose
- Is temporary
- Is developed in an iterative fashion
- Requires resources, often from diverse interests
- Should have a primary customer or sponsor.
  - The **project sponsor** usually provides the direction and funding for the project
- Involves uncertainty (risk)

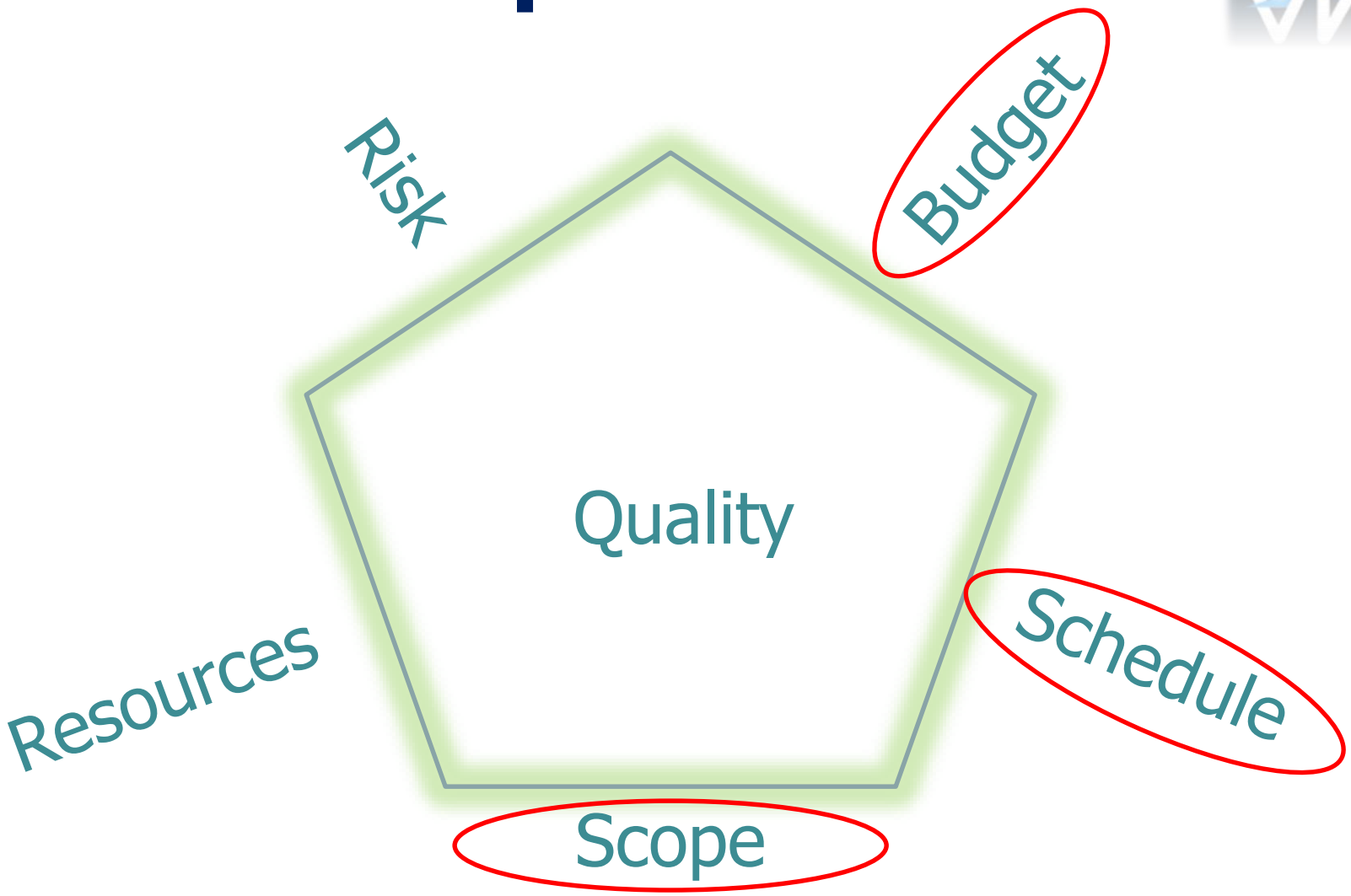
Project management defined

Project management is "the application of knowledge, skills, tools and techniques to project activities to meet project requirements."

A **methodology** describes how processes are executed in an organization.

Source: PMBOK Guide 4th Edition - PMI

The Triple Constraint



The Project Mgmt. Office

- A **project management office** (PMO) is an organizational entity created to assist project managers in achieving project goals

- A **PMO** can help development standards and methodologies, provide career paths for project managers, and assist project managers with training and certification

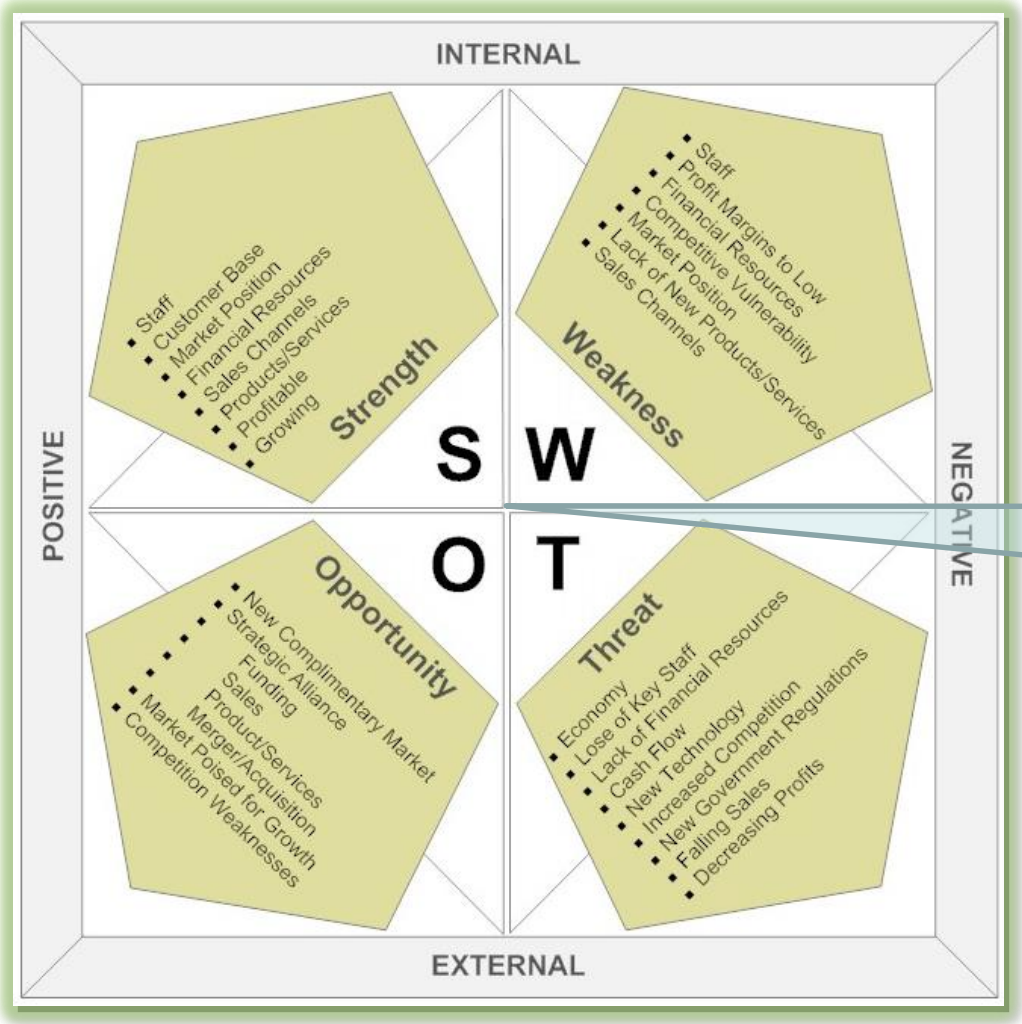
Source: Schwalbe, Information Technology Project Management, Sixth Edition, 2010

Projects/Programs /Portfolios

	PROJECTS	PROGRAMS	PORTFOLIOS
Scope	Projects have defined objectives. Scope is progressively elaborated throughout the project life cycle.	Programs have a larger scope and provide more significant benefits.	Portfolios have a business scope that changes with the strategic goals of the organization.
Change	Project managers expect change and implement processes to keep change managed and controlled.	The program manager must expect change from both inside and outside the program and be prepared to manage it.	Portfolio managers continually monitor changes in the broad environment.
Planning	Project managers progressively elaborate high-level information into detailed plans throughout the project life cycle.	Program managers develop the overall program plan and create high-level plans to guide detailed planning at the component level.	Portfolio managers create and maintain necessary processes and communication relative to the aggregate portfolio.
Management	Project managers manage the project team to meet the project objectives.	Program managers manage the program staff and the project managers; they provide vision and overall leadership.	Portfolio managers may manage or coordinate portfolio management staff.
Success	Success is measured by product and project quality, timeliness, budget compliance, and degree of customer satisfaction.	Success is measured by the degree to which the program satisfies the needs and benefits for which it was undertaken.	Success is measured in terms of aggregate performance of portfolio components.
Monitoring	Project managers monitor and control the work of producing the products, services or results that the project was undertaken to produce.	Program managers monitor the progress of program components to ensure the overall goals, schedules, budget, and benefits of the program will be met.	Portfolio managers monitor aggregate performance and value indicators.

Source: PMBOK Guide 4th Edition - PMI

SWOT Analysis



SWOT analysis involves analyzing:

- Strengths
- Weaknesses
- Opportunities
- Threats

This analysis can help you identify potential projects that align with company goals and strategic objectives.

[Know your SWOT (inc.com)]

Source: bizstrategies.biz

Process Groups & Knowledge Areas

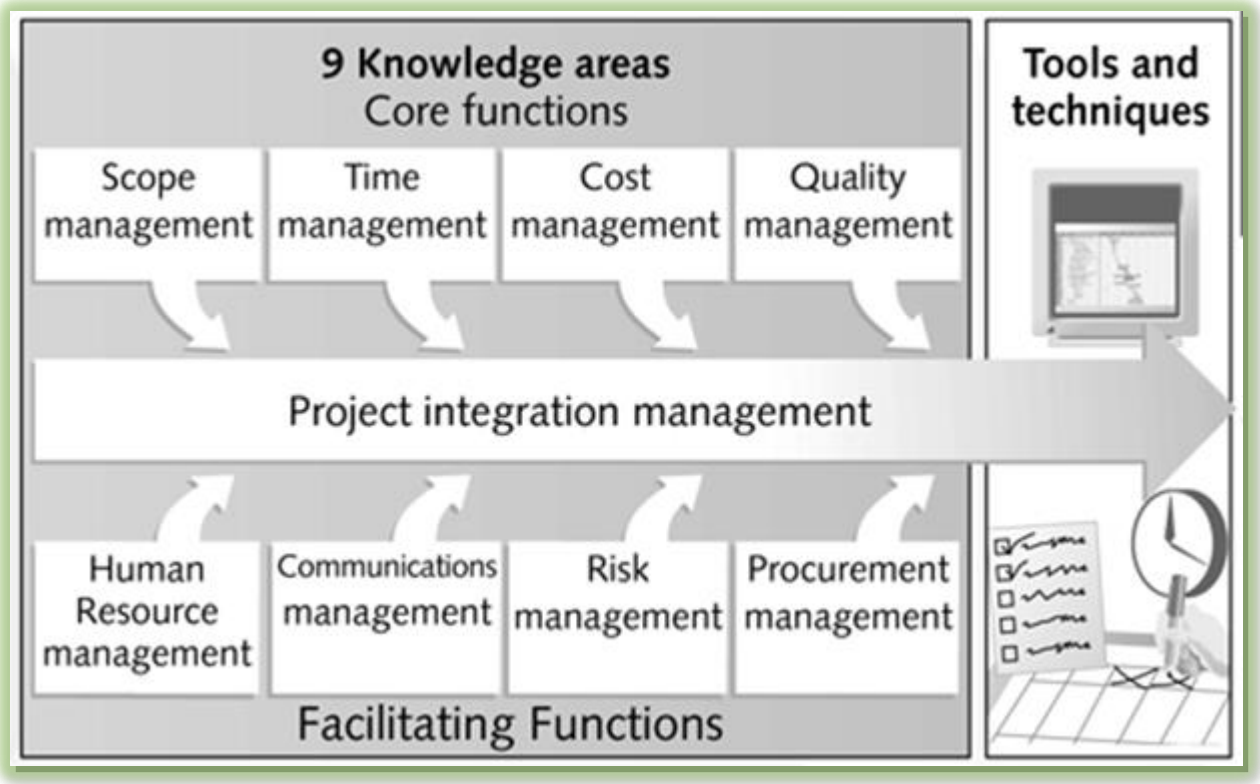
Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS		5.4 Verify Scope 5.5 Control Scope	
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget		7.3 Control Costs	
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance	8.3 Perform Quality Control	
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Distribute Information 10.4 Manage Stakeholder Expectations	10.5 Report Performance	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Monitor and Control Risks	
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements	12.3 Administer Procurements	12.4 Close Procurements

Source: PMBOK Guide 4th Edition - PMI

PM Process Groups/Phases

- **Initiating processes** - actions to begin projects and project phases
- **Planning processes** -articulating workable plan to ensure that the project meets its scope, time, and cost goals as well as business needs
- **Executing processes -** coordinating resources (human, material) to act on project plans and produce the deliverables of the project or phase. Deliverable - product or service produced or provided as a result of executing the project.
- **Monitoring and controlling processes** measure progress toward achieving project goals, monitor deviation, and perform corrective action to match progress with plans and customer expectations.
- **Closing processes** - formalizing acceptance of the project or phase and bringing it to an orderly and organized end.

The Nine Knowledge Areas



Source: Schwalbe, Information Technology Project Management, Sixth Edition, 2010

Project Initiation

Before Initiating a Project…

After a project has gone through the selection and approval process, there are some important pre-initiating tasks to address:

- Determine the scope, time, and cost constraints for the project (triple constraint)
- Identify the project sponsor/champion
- Select the project manager
- Consult with the project manager to review the process and expectations for managing the project

The Business Case

- **Business case** is a document that provides justification for investing in a project (financial, strategic, regulatory)
- Possible contents:
  - Introduction/Background
  - Business Objective
  - Current Situation and Problem/Opportunity Statement
  - Critical Assumptions and Constraints
  - Analysis of Options and Recommendation
  - Preliminary Project Requirements
  - Budget Estimate and Financial Analysis
  - Schedule Estimate
  - Potential Risks
  - Exhibits/Supporting Documentation

Initiation Knowledge Areas

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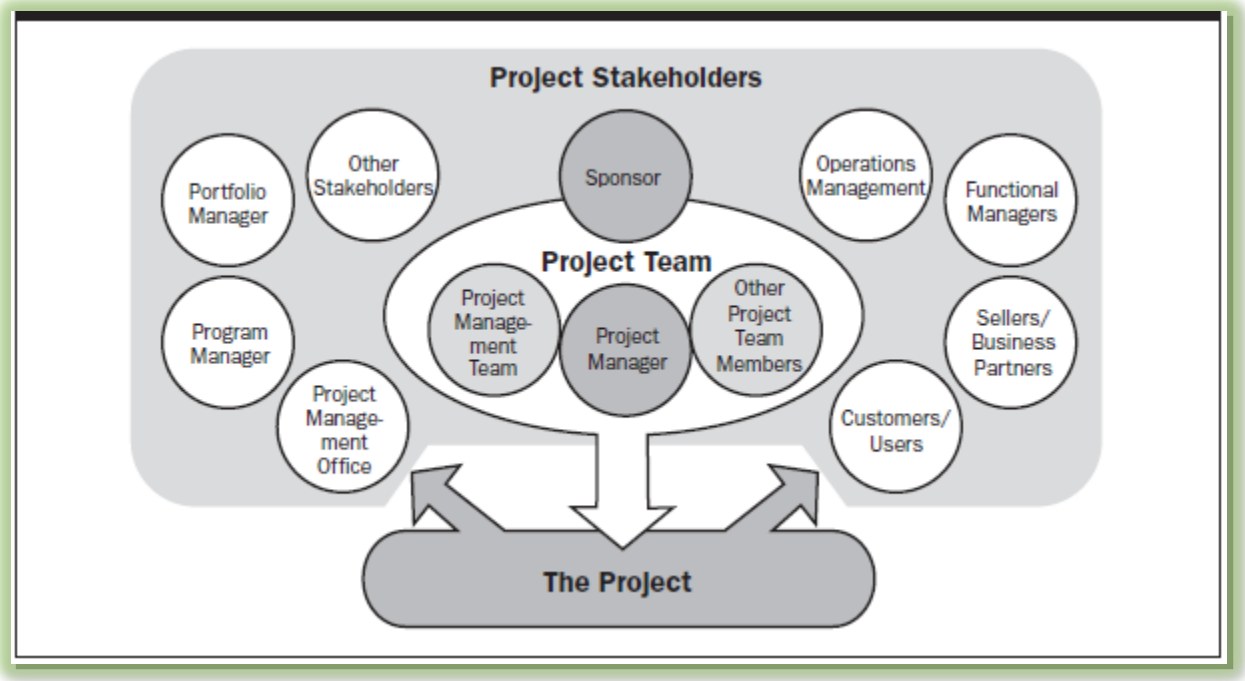
The importance of stakeholders



"Stakeholders are persons or organizations who are actively involved in the project or whose interests may be positively or negatively affected by the performance or completion of the project."

Source: PMBOK Guide 4th Edition - PMI

The Project Charter

The **project charter**

- formally recognizes the existence of a project and provides a summary of the project's objectives and management
- authorizes the project manager to use organizational resources to complete the project
- should contain a sign-off section in which key stakeholders "sign-off" to acknowledge of all of the formalities of the charter (scope, business case, goals, etc.)

Project Planning

Why does project planning matter?

Insert your favorite catch phrase here:

- If you fail to plan, you plan to fail.
- If you don't know where you're going, any road will take you there.
- What gets measured gets managed (done).

The main purpose of project planning is to guide project execution, so project plans must be realistic and useful

Source: Schwalbe, Information Technology Project Management, Sixth Edition, 2010

Planning Knowledge Areas

Knowledge Areas	Project Management Process Groups				
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The Project Management Plan

Some common components of the project plan

- Overview of the project
- Project organization
- Management and technical processes
- High-level description of work to be performed
- Project schedule information
- Project budget information
- References to other project planning documents

Project Time Management

Project Time Management Planning Includes:

- Defining Activities
- Sequencing Activities
- Estimating Activity Durations
- Estimating Resource Needs
- Likely outputs
  - Activity List
  - Milestone List
  - Resource Requirements
  - Project Schedule

The Importance of Milestones

Milestone - a *significant* event in a project

- More specifically, has no cost or time duration associated with it.

Examples of potential milestones in a project:

- Sign-off of key documents (charter, reqts.)
- Completion of specific deliverables
- Completion of important process-related work, or particular phases in a multi-phased project

Sometimes may also be called 'toll gates'

Defining Milestones

When defining milestones in your project, make sure that you keep them SMART:

- **S**pecific
- **M**easureable
- **A**ssignable
- **R**ealistic
- **T**ime-bound

Sequencing Activities

To properly sequence activities review the activity list, project scope statement, and milestone list to determine the relationships or dependencies between activities.

Activity sequencing is determined by the type of relationships or *dependencies* that exist between activities.

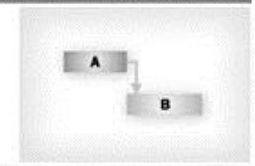
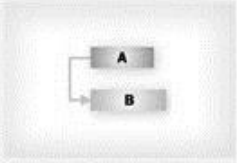
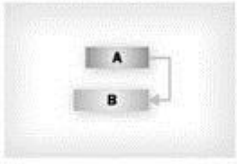
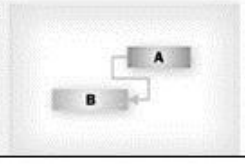
Examples:

- Does one activity have to finish before the next one starts?
- Can the execution of certain activities overlap?
- Can certain activities be performed in parallel?

Sequencing activities properly is a key aspect of building & managing an effective project schedule.

Types of Dependencies

Activity Precedence Examples

Link type	Example	Description
Finish-to-start (FS)		The dependent task (B) cannot begin until the task that it depends (A) on is complete.
Start-to-start (SS)		The dependent task (B) cannot begin until the task that it depends (A) on begins.
Finish-to-finish (FF)		The dependent task (B) cannot be completed until the task that it depends on (A) is completed.
Start-to-finish (SF)		The dependent task (B) cannot be completed until the task that it depends on (A) begins.

Finish-to-start:
Task A – Create Project Charter
Task B – Obtain Project Charter Approval
Logic: You must create the Project Charter before you can get it approved

Start-to-Start:
Task A – Paint the Walls
Task B – Hang the Wallpaper
Logic: Minimize the disruption in both rooms by having both activities start at same time

Finish-to-Finish:
Task A – Cook Turkey
Task B – Cook Potatoes
Logic: You want the turkey and potatoes to finish cooking at the same time so as to serve the whole meal hot.

Start-to-Finish:
Task A – Fertilize the garden
Task B – Water the garden
Logic: Start the watering to get the plants wet before beginning the fertilization.

Source: Schwalbe, Information Technology Project Management, Sixth Edition, 2010

Critical Path Analysis

What exactly is the "**critical path**"?

- The series of activities that determine the earliest time by which the project can be completed
- The activities that determine the duration of the project
- The path in your network diagram that, if it becomes delayed, will delay the entire project
- Longest path through the network diagram and has the least amount of *slack or float*

Slack (float) – The amount of time an activity can be delayed without delaying the subsequent activity or the project finish date.

Project Cost Management

Project Cost Management Planning Includes:

- Estimating Costs
  - Fine-tuned over the course of the project
  - Large amount of costs are usually tied to labor
- Determining a budget
  - Allocate the cost to project activities over time
- Producing a project cost baseline
  - A time-phased baseline used to monitor & measure project performance over time
  - Used in Earned Value Analysis

Project Quality Management

What is Quality?

- Per ISO – "The degree to which a set of inherent characteristics fulfill requirements"
- Conformance to Requirements – meet documented specifications
- Fitness for Use – can be used as was originally intended

When all is said and done, your customer will ultimately determine if your project has produced "quality" or not.

Project Quality Management Planning Includes

- Ensuring that the product will state the implied or expressed needs
- Defining metrics that will measure success
- Producing outputs
  - Quality management plan
  - Project Dashboards

Quality Metrics

Metric - a standard of measurement

Metrics allow organizations to measure their performance in certain areas and to use them as a method of comparison for themselves over time or with other organizations.

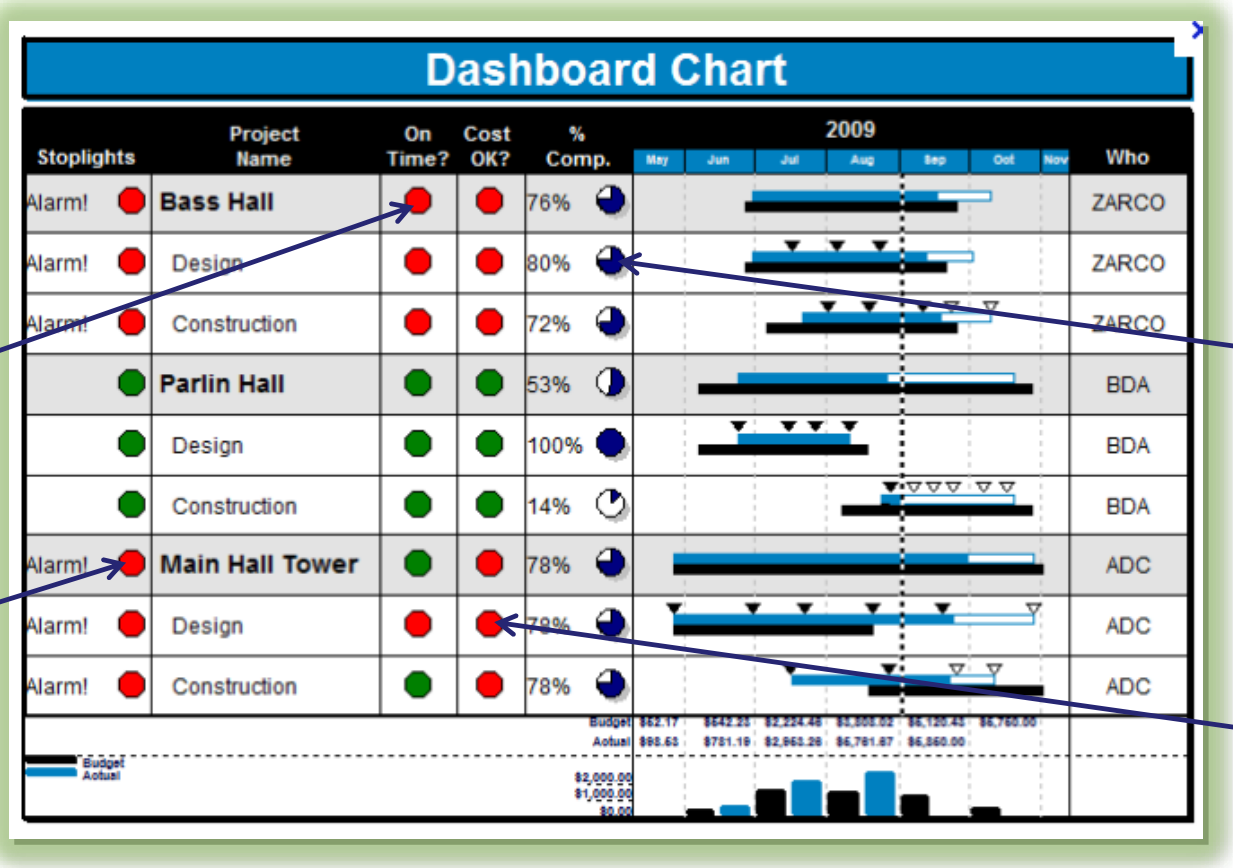
Examples of metrics used in organizations:

- Time (cycle time, speed of answer, queue time)
- Financial (NPV, ROI, cost avoidance)
- Customer Satisfaction (industry rankings, feedback)
- Sigma – common, can be used across industries

Project Dashboards

Project Dashboard – A means of tracking and summarizing key project metrics

Tracks the KPI's (Key Performance Indicators) that signify project health



Project Human Resource Management

Project human resource management is concerned with making effective use of the people involved with a project

Possible outputs from a project human resource management plan:

- Project organizational chart
- Responsibility Assignment Matrix
- Resource Histogram
- Resource Staffing Plan

Responsibility Assignment Matrix

Responsibility assignment matrix (RAM) is a matrix that maps the work of the project as described in the work breakdown structure (WBS) to the people responsible for performing the work

Responsible: The person who does the work to achieve the task. They have responsibility for getting the work done or decision made. As a rule this is one person; examples might be a business analyst, application developer or technical architect.

Accountable: The person who is accountable for the correct and thorough completion of the task. This must be one person and is often the project executive or project sponsor. This is the role that responsible is accountable to and approves their work.

Consulted: The people who provide information for the project and with whom there is two-way communication. This is usually several people, often subject matter experts.

Informed: The people who are kept informed about progress and with whom there is one-way communication. These are people that are affected by the outcome of the tasks so need to be kept up-to-date.

RACI Matrix example

Step	Project Initiation	Project Executive	Project Manager	Business Analyst	Technical Architect	Application Developers
1	Task 1	C	A/R	C	I	I
2	Task 2	A	I	R	C	I
3	Task 3	A	I	R	C	I
4	Task 4	C	A	I	R	I

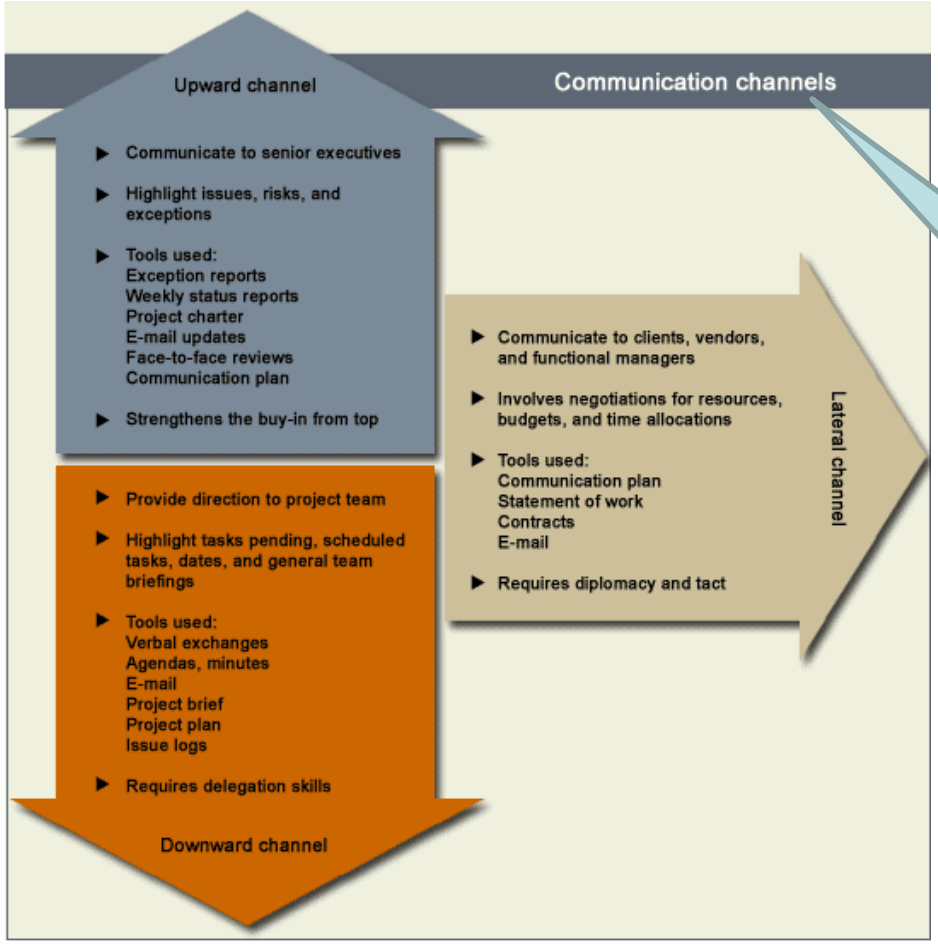
Project Communications Management

Why are Project Communications Important?

- Many experts agree that the greatest threat to the success of any project is a failure to communicate
- Many project managers say that 90 percent of their job is communicating, yet many project managers fail to take the time to plan for project communications

Project communications management is solely about generating, collecting, disseminating, and storing project information.

What type of communication to use?



Moral of the story here: Realize that as a project manager you will have to engage in many types of communication at various levels of the company with disparate stakeholders. Know which communication mediums are most appropriate for each intended audience.

Source: http://www.techrepublic.com

Project Risk Management

Risk - an uncertainty that can have a negative or positive effect on meeting project objectives.

Some schools of thought consider only negative uncertainties as risks, while they classify positive uncertainties as opportunities.

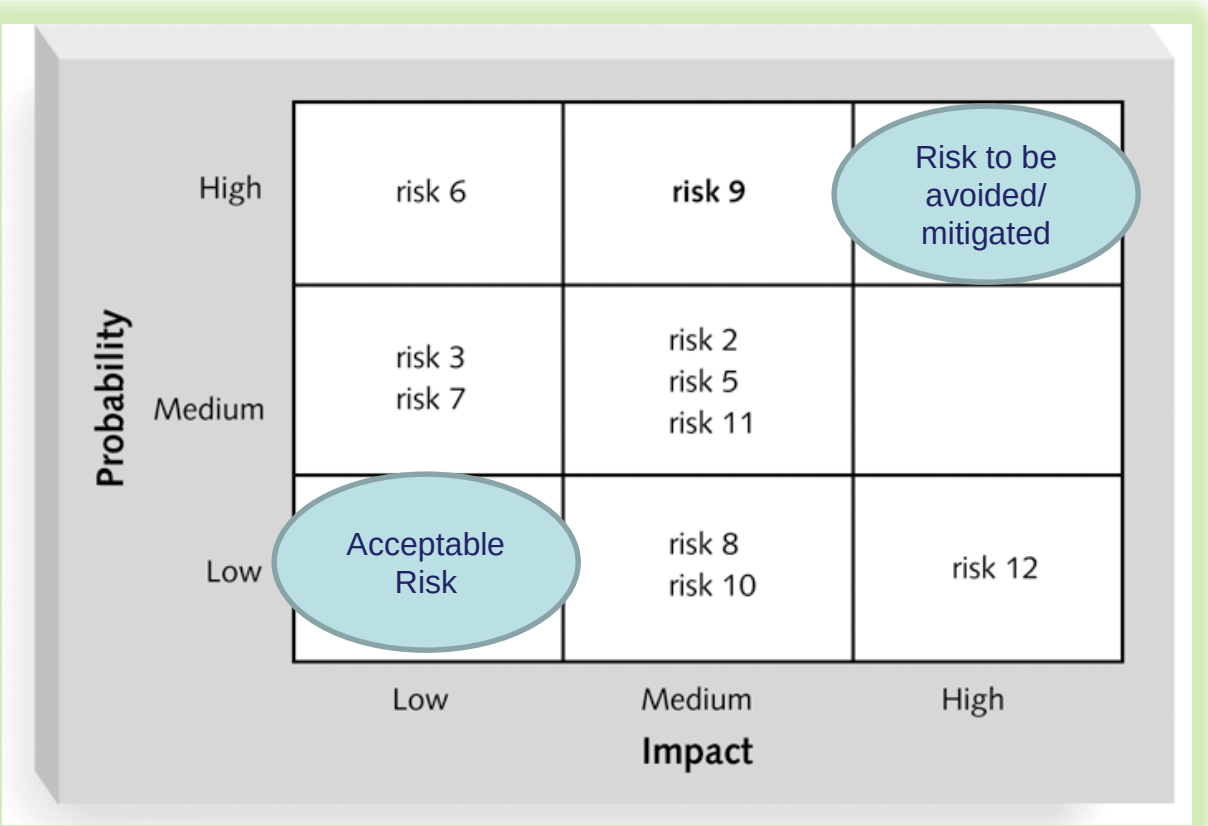
Possible outputs from a Project Risk Management:

- Risk Management Plan
  - Contingency Plans
  - Fallback plans
- Probability/Impact Matrix
- Risk Register

Probability/Impact Matrix

Probably – How likely is the risk event to occur

Impact – How severe an impact will the risk have on the success of the project.



Risk Registers

Risk register - a document that contains the results of various risk management processes and evaluations, and acts as a mechanism for documenting potential risk events and strategies to address them.

Specifically a risk register may include information such as:

- An identification number for each risk event
- A rank for each risk event (usually high, medium, or low)
- The name of the risk event
- A description of the risk event
- The category under which the risk event falls
- The root cause: The real or underlying reason a problem occurs
- Triggers: Indicators or symptoms of actual risk events
- Potential responses to each risk event
- The risk owner, or person who will own or take responsibility
- The probability of the risk event occurring
- The impact to the project if the risk event occurs
- The status of the risk event

Project Procurement Management

Project procurement management includes acquiring or procuring goods and services for a project from outside the organization

Why is it important?

- Business is more global in nature
- More and more competitive pressures on organizations
- Cost pressures, having to do more with less
- Specialized needs and the make-vs.-buy proposition

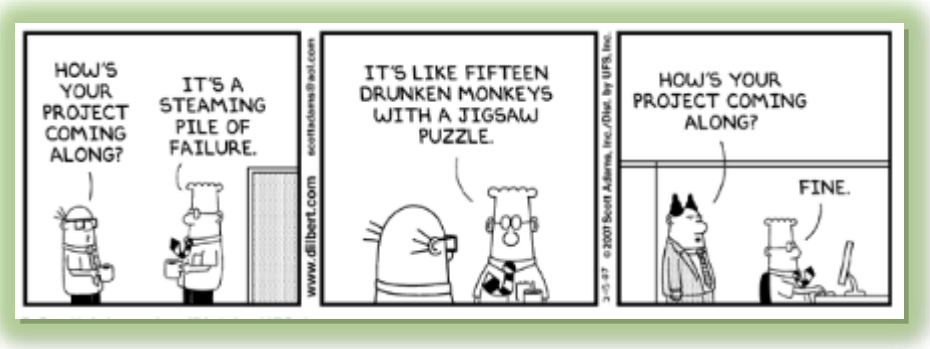
Possible outputs of project procurement management:

- Procurement Management Plan
- Make-or-buy analyses
- Statements of Work
- Source Selection Criteria

Project Execution

Why does project execution matter?

- By default, it is the process group that is most evident during the performance of the project
- Majority of a project's time and budget is spent on the execution phase
- If a Project Manager is going to fail, the execution phase is typically where that failure is most likely to occur



Project Integration Management

Key Outputs in the Execution Phase

- Deliverables - products or services produced or provided as part of a project
- Work Performance Data – Formal communications, status reports, Management by Walking Around (MBWA)
- Change Requests – Make sure to have a process for collecting & approving changes
- Project Management Plan Updates
- Project Document Updates

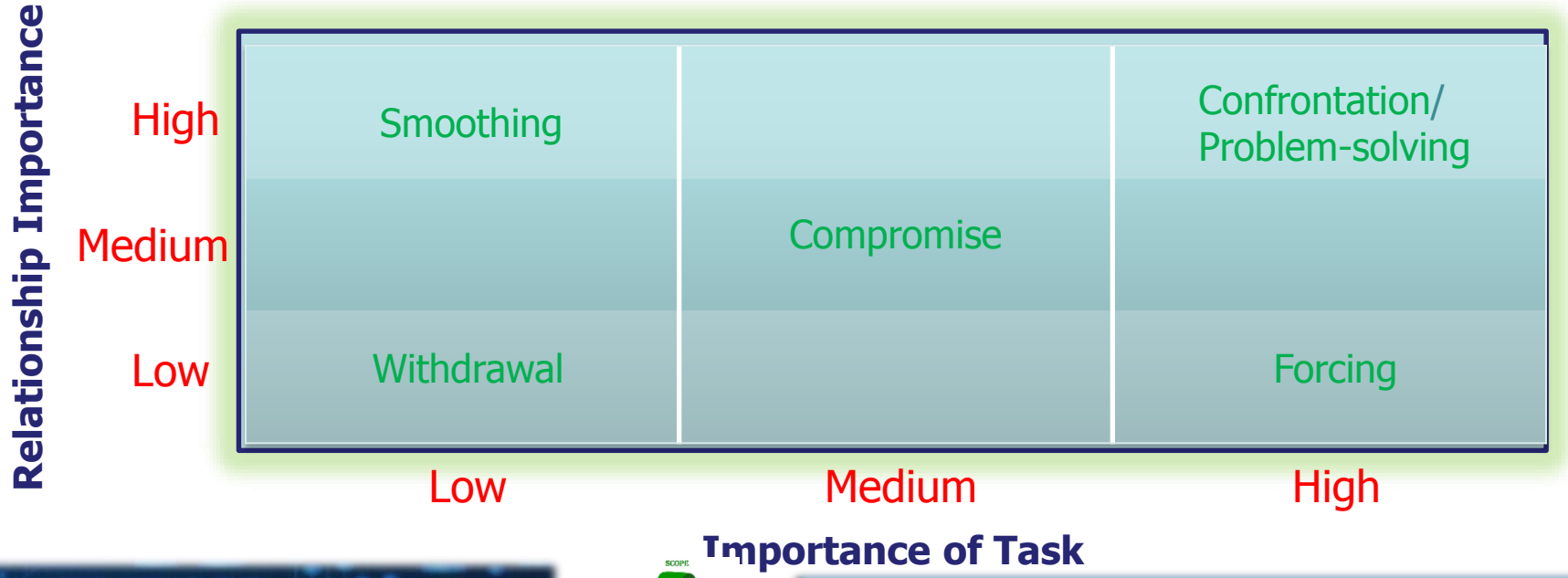
Common Execution Problems

Key Danger Signs encountered during execution

- Project Scope is unclear or poorly defined
- Weak or non-existent support from project champion and senior management
- Time and cost expectations are unrealistic
- Competing priorities are endangering resource allocations to the project
- Conflict is not being managed properly
- Communication is poor or non-existent

Conflict Management

- **Confrontation:** Directly address the conflict.
- **Compromise:** Give-and-take.
- **Smoothing:** De-emphasize negative, accentuate positive.
- **Forcing:** Someone wins, someone loses.
- **Withdrawal:** Avoid disagreement at all costs.



Project Quality Management

- **Quality assurance** activities related to satisfying the specific quality expectations for a project, also, insure that quality improvement is continuous.

Key Outputs in the Execution Phase

- Change Requests
- Project Management Plan Updates
- Project Document Updates

Project Human Resource Management

Since projects are executed by human beings, picking the right team is crucial to the success of the project.
The project manager generally has responsibility for

- Acquiring the Team
- Developing the Tem
- Managing the Team

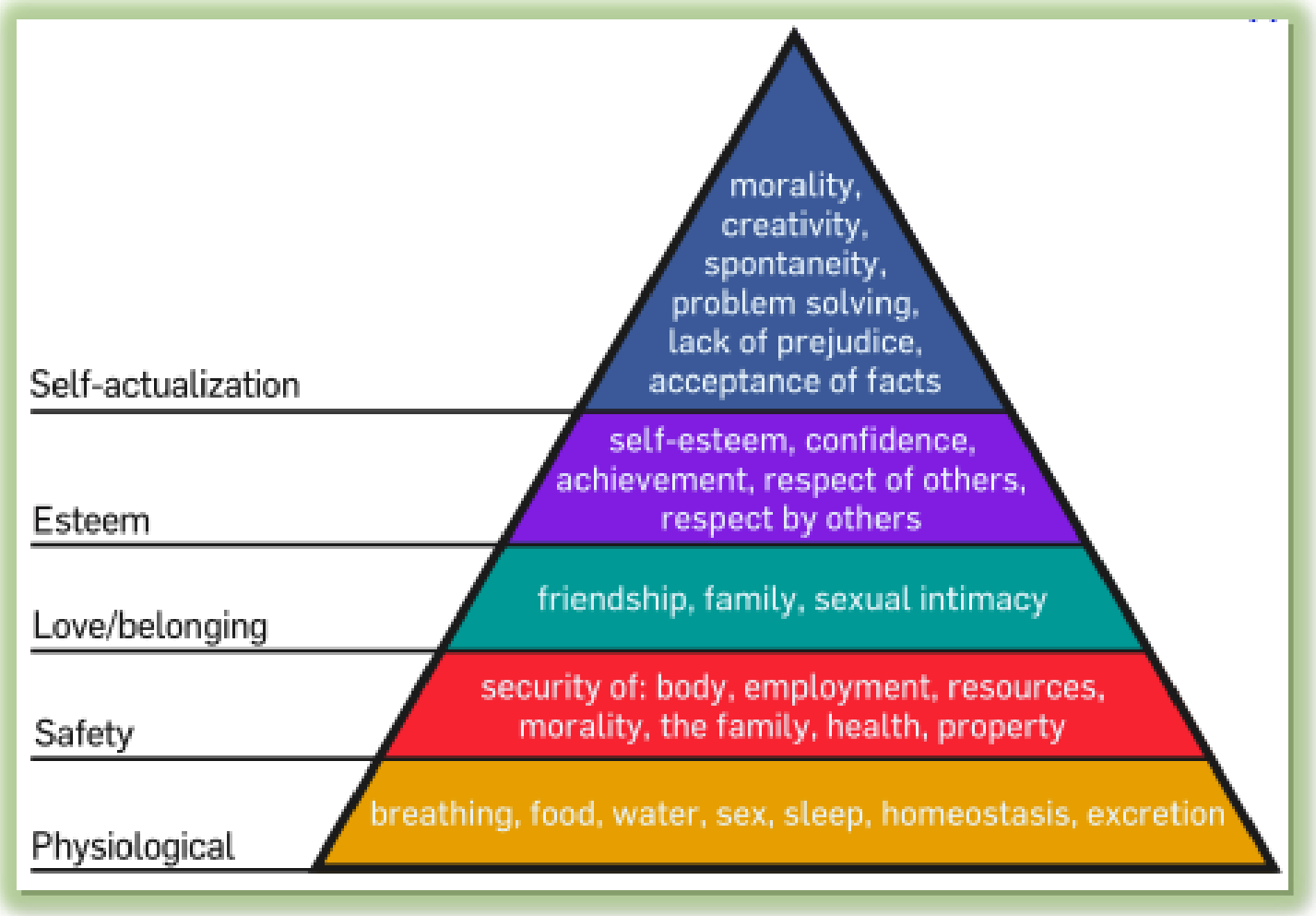
Finding motivation

Radical Idea: To lead others effectively in project execution a project manager must understand what motivates individuals to act.

Intrinsic vs. Extrinsic motivation:

- Intrinsic – The performance of an act solely for the purpose of one's own enjoyment and self-gratification.
- Extrinsic – The performance of an act solely for the purpose of avoiding some sort of penalty or punishment.

The Maslow Hierarchy



Source: Wikipedia

McGregors Theory X and Y

Theory X: Assumption that individuals dislike and avoid work, so managers must use coercion, threats and various control schemes to get workers to meet objectives.
Subscribing to this theory means a project manager typically uses these means of motivation/influence:

- Authority
- Compensation
- Punishment

Theory Y: Assumption that individuals consider work as natural as play or rest and enjoy the satisfaction of esteem and self-actualization needs.
Subscribing to this theory means a project manager typically uses these means of motivation/influence:

- Subject Matter Expertise
- Challenging/Fulfilling Work

Which theory do you buy into and why?

Building Rapport

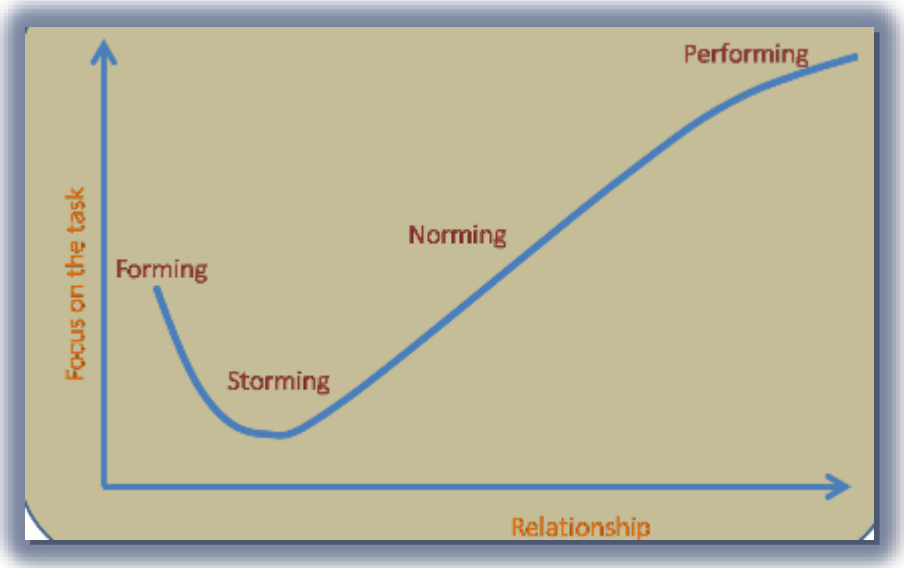
At any given time on a project, a project manager may assume one or more of the following roles:

- Leader
- Counselor
- Critic
- Therapist
- Mentor
- Friend

Know when you have to assume any one of these roles (plus others) and never underestimate the power of *listening*.

Optimizing Team Performance

As project manager, while you may be successful in assembling a team of highly-talented individuals, you will still not reach the team's full potential unless you get those individuals to operate as a team



- Forming
- Storming
- Norming
- Performing
- Adjourning

Tuckman's Team Development Stages

Synergy – the whole is greater than the sum of the parts.

Tips to managing teams

- When addressing problems, keep the focus on issues not people
- Have regular, effective meetings (with agendas)
- Allow time for the normal team development stages
- Keep work teams small in order to make communications more effective
- Have social, non-work activities to help stakeholders become acquainted and more comfortable with each other
- Stress team purpose and identity over individual achievement
- Provide mentoring where appropriate and encourage mentoring and knowledge share across team members
- Acknowledge individual and group accomplishments
- Patience is a virtue

Communications during Execution

Some things to always keep in mind:

- Formal and informal communications
  - Status reports are not enough
  - Many people prefer conversation to written correspondence
- Nonverbal communications
  - Pay close attention to the use of body language
- Use the appropriate communications medium
- Understand the impact of team size on project communications

Project Monitoring & Control

Monitor/Control Knowledge Areas

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS		5.4 Verify Scope 5.5 Control Scope	
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget		7.3 Control Costs	
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance	8.3 Perform Quality Control	
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Distribute Information 10.4 Manage Stakeholder Expectations	10.5 Report Performance	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Monitor and Control Risks	
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements	12.3 Administer Procurements	12.4 Close Procurements

Project Scope Management

The main monitoring and controlling tasks performed as part of project scope management are verifying scope and controlling scope

So, what is "Scope Creep"??:
-- the tendency for a project scope (that is, the definition of the work to be accomplished) to grow ever larger during the life span of the project.

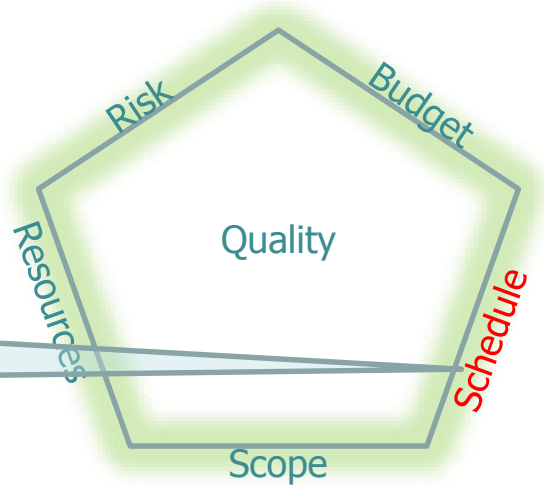
Note: You *cannot* control the scope of a project unless you have first clearly defined the scope and set a scope verification process in place, that is to say, making sure that all key stakeholders have a means of formal acceptance of the scope.

Any changes to scope must be governed by a change control process.

Project Time Management

- Project managers often cite delivering projects on time (schedule control) as one of their biggest challenges, because schedule problems often cause more conflict than other issues
- During project initiation, priorities and procedures are often most important, but as the project proceeds, schedule issues become the predominant source of conflict
- Keep in mind this fact: Time is the least flexible variable of the "triple constraint". Above all, lost time is the one resource you cannot recover.

When reporting project schedule compliance to senior management, make sure those communications are clear and truthful. The only thing senior management hates more than being surprised is being mis-led.



Project Quality Management

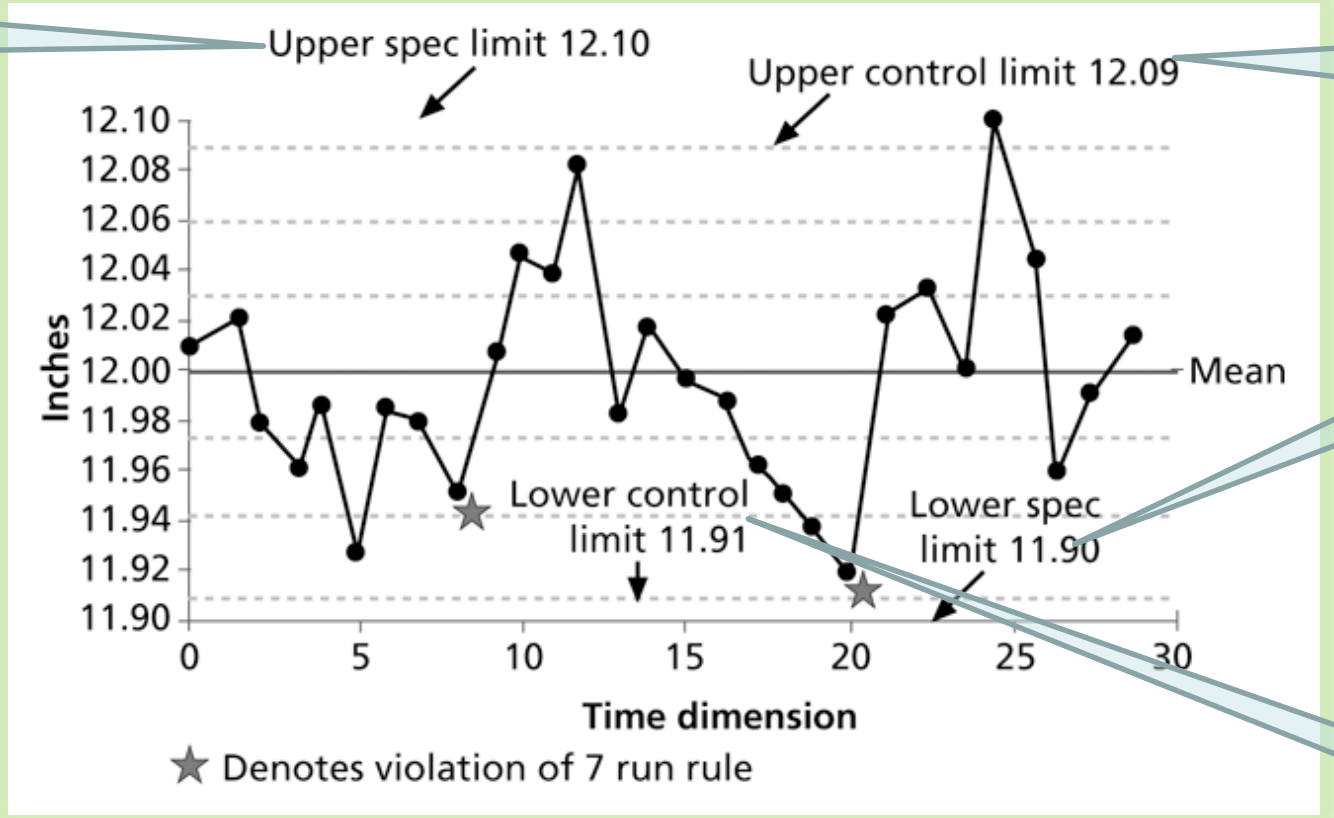
Main objective: Performing quality control to insure that project deliverables meet customer standards (CTQs)

Possible tools:

- Cause-and-effect (fishbone)diagrams: Find the root cause of quality issues
- Control charts: Illustrate the results of a process over time to demonstrate if a process is in control
- Run charts: Display the history and pattern of variation of a process over time
- Scatter diagrams: Identify if there is a relationship (correlation) between two variables
- Histograms: A bar graph of a distribution of variables
- Pareto charts: Help you identify and prioritize problem areas (80/20 rule)
- Flowcharts: Display the logic and flow of processes that help you analyze how problems occur and how processes can be improved

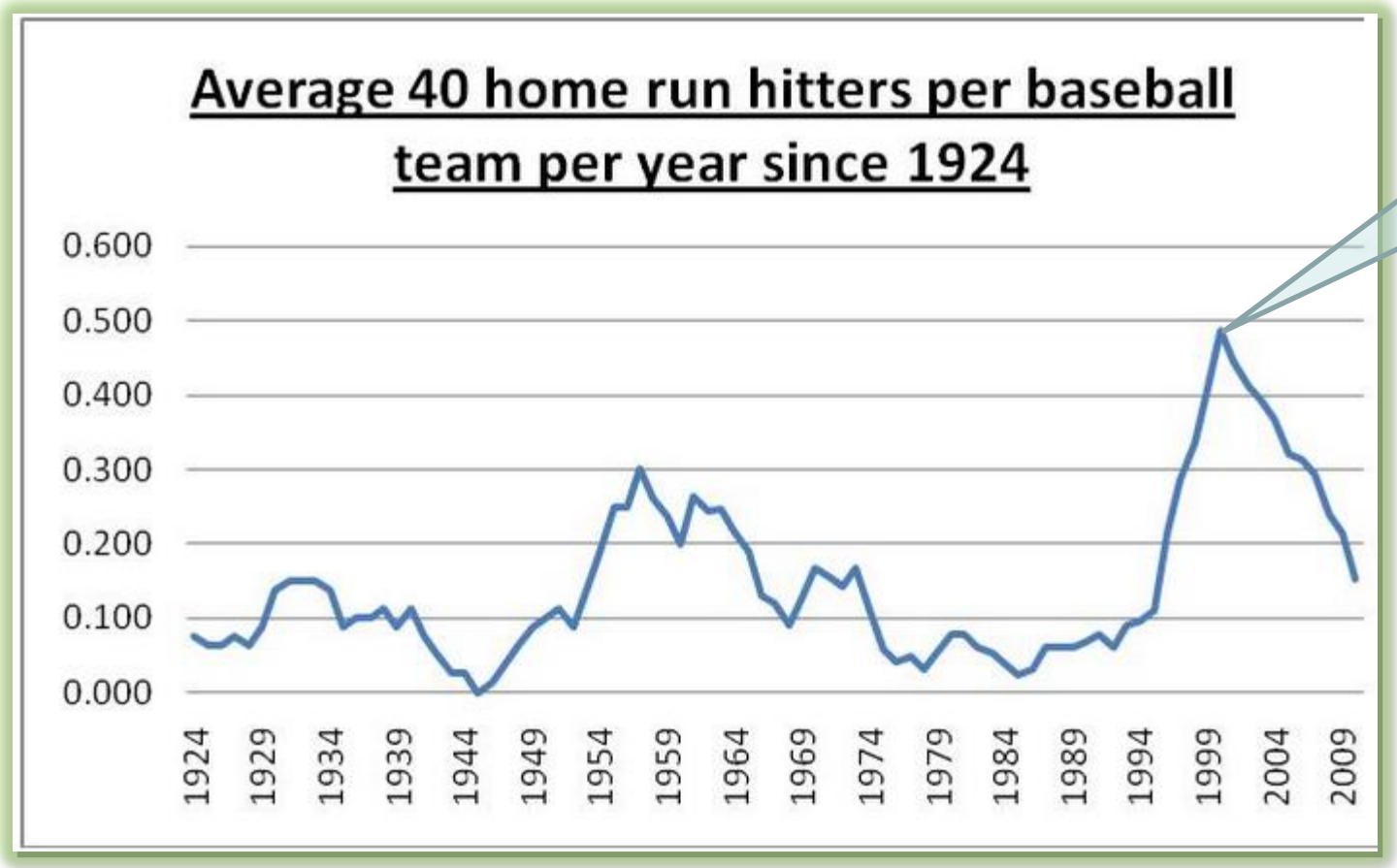
Control Chart

…shows the performance of a CTQ measurement over time



Run Chart

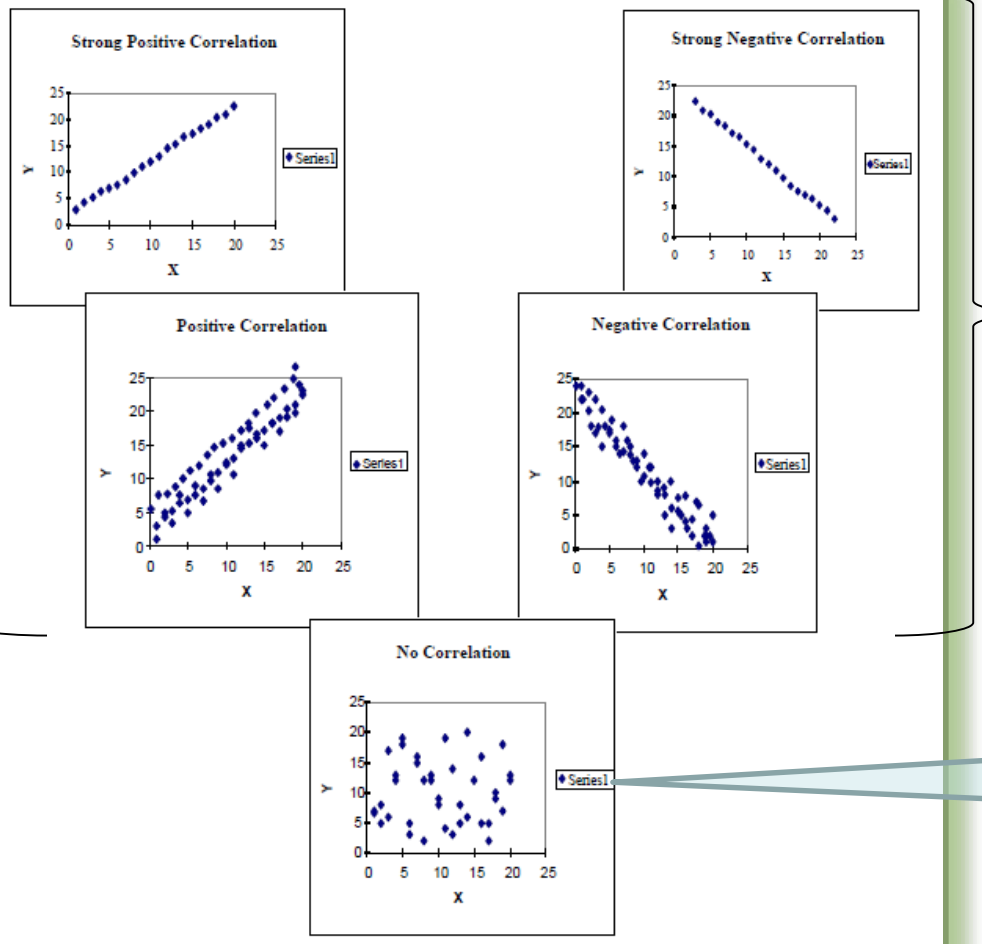
...displays the history and pattern of variation of a process over time



Scatter Diagrams

...attempting to show a relationship (correlation) between two variables

X = # of years driving past age 65
Y = Occurrence of accidents per 1000 in population

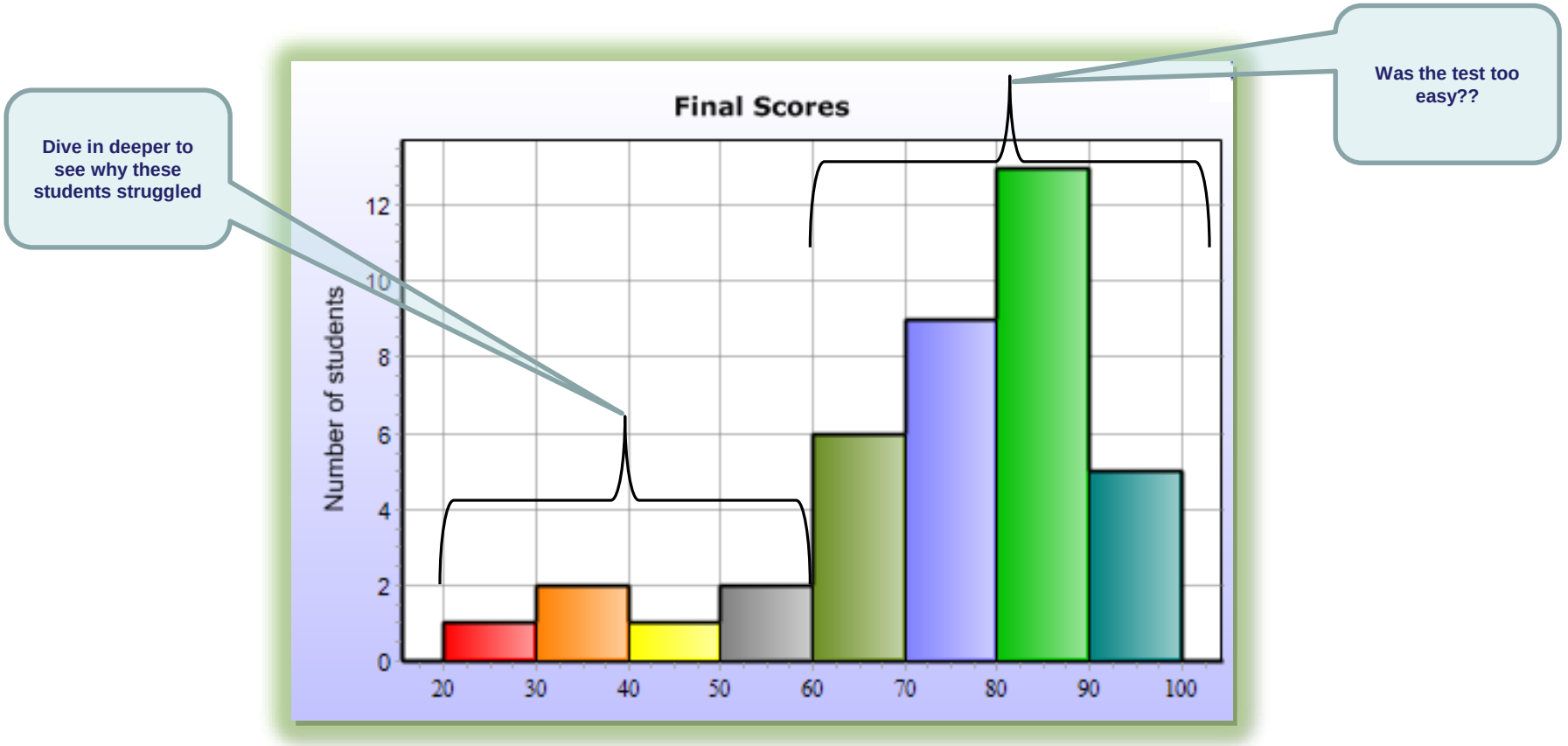


X = Years of driving experience
Y = # of accidents per 1000 in population

X = 100's of redheads in driving population
Y = # of accidents per 1000 in population

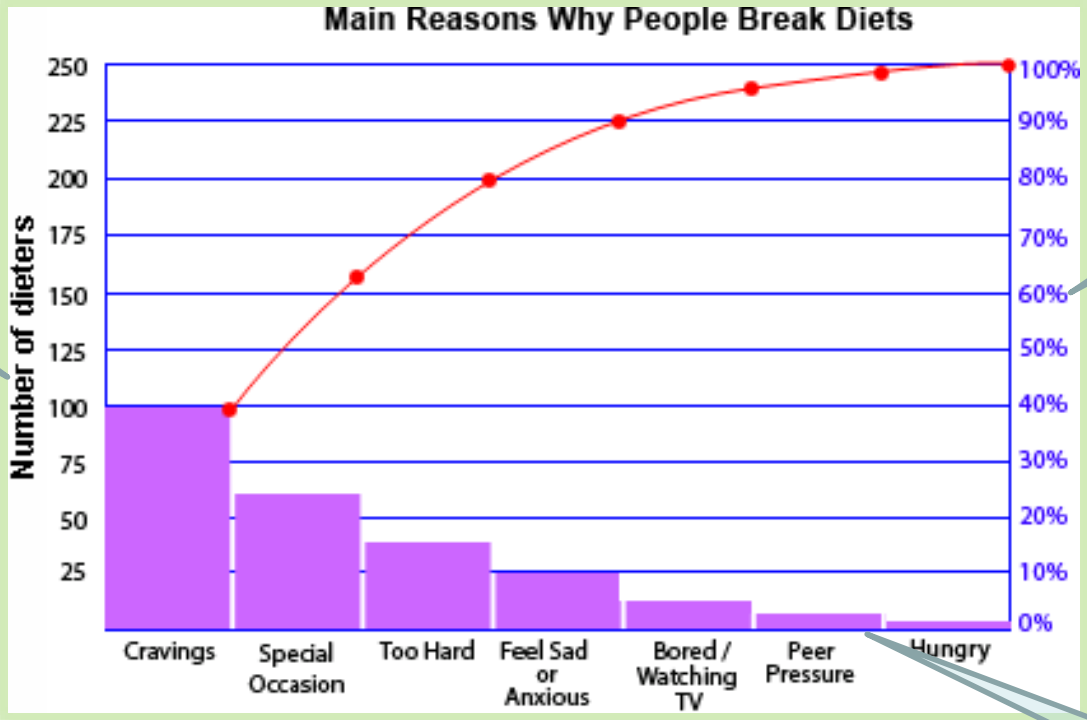
Histograms

...displays a distribution of values across a range



Pareto Chart

…identifies key areas that cause an issue



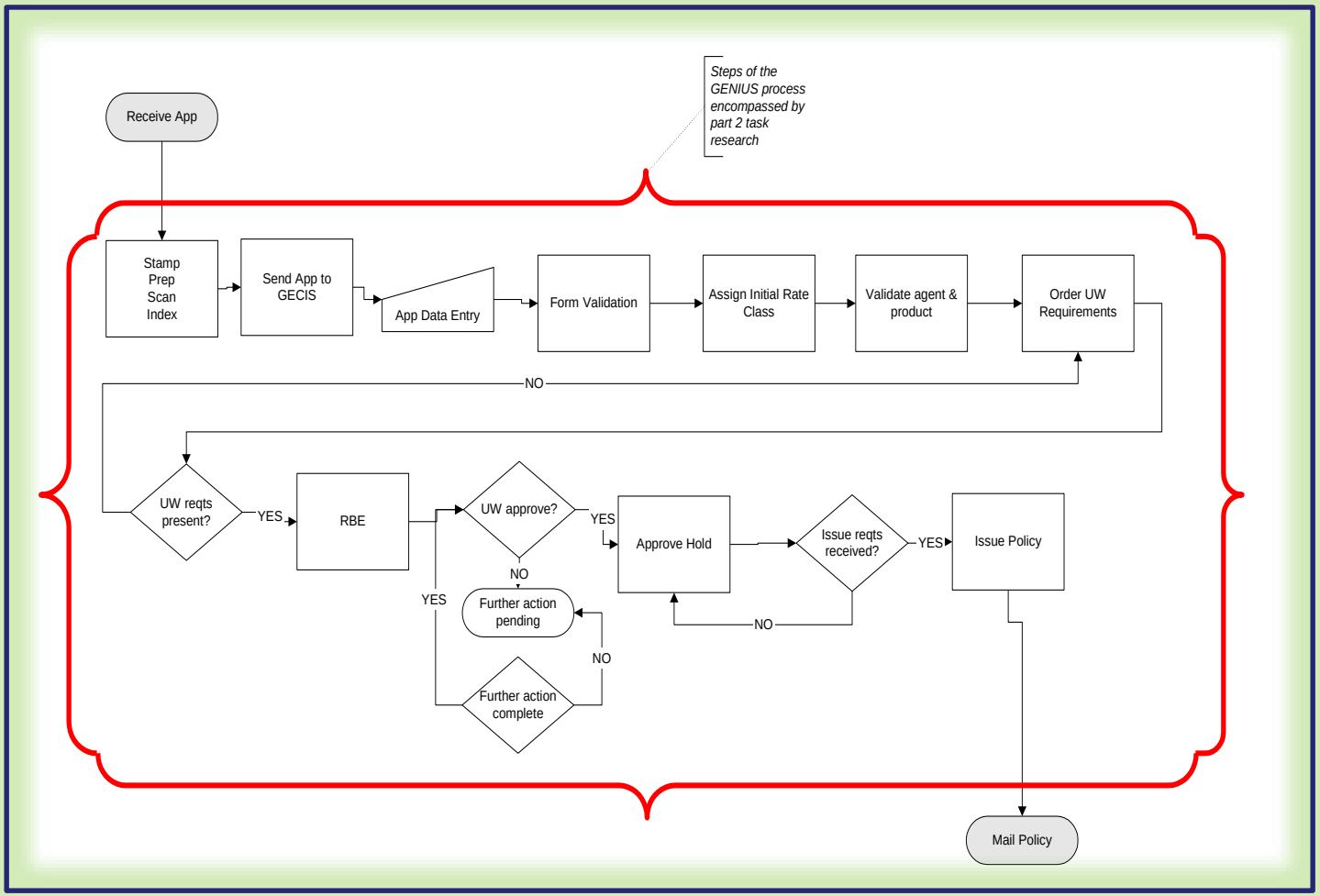
Absolute values

Cumulative percentage

Area causing the issue or 'defect'

Flowchart (process map)

...graphically displays how a particular process works



Project Closing

Closing Knowledge Areas

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Project Integration Management

Key tasks:

- Transition the Deliverable(s): Insure that final products, services, or results are delivered and transitioned to the appropriate part of the organization
- Sign-off: Gain *formal* stakeholder and customer acceptance of the project deliverable(s) and verify all are complete.
- Lessons Learned: Conduct a *formal* review of overall project performance, understanding and analyzing both what went wrong and right with the project. -- "Those who do not learn from history are doomed to repeat it."
- Transition: Plan for and execute a smooth transition of the project (and project team members) into the normal operations of the organization.
- Knowledge Transfer: Recognize that employee knowledge or human capital is one of the key project assets

Project Procurement Management

Key tasks:

- **Contract Settlement:** Insure that final products, services, or results are delivered and transitioned to the appropriate part of the organization.

- **Audits:** Conduct procurement audits in order to identify lessons learned during the procurement process.

- **Records Management:** Have a record management system for organizing and archiving procurement documents.

Close Out Meeting

Key aspects of the close-out meeting:

- Invite Key project stakeholders.
- Have project champion start off the meeting
- Project manager and his/her team should review following information:
  - The scope, time, and cost goals and outcomes
  - The success metrics and were they met
  - Key changes that occurred during the project and how they were addressed
  - The Lessons Learned exercise
  - The transition plan

After the close-out meeting, make sure that your team has some sort of celebration to acknowledge the accomplishments of the project.

Key Takeaways

Key Takeaways

Stakeholders: Involve all key project stakeholders early and often during the course of a project. Keep them consistently engaged and informed.

Project Selection: Develop and follow a formal project selection process to ensure projects align with business needs and strategic objectives.

Planning: Lay the groundwork for projects before they officially start by committing the proper amount of due diligence to the planning process. "Fail to Plan, Plan to Fail"

Support: Designate a project champion early on to provide high-level support and visibility to senior management.

Key Takeaways

PM mindset: Provide mentoring and training for project managers and other stakeholders stressing the importance of the project management methodology as a key to project success.

Meeting rigor: Prepare an agenda for each meeting, adhere to time constraints, document quickly action items & minutes, and set the next meeting time.

Change Control: Develop and follow a formal change-control process to insure scope is kept in check.

Communication: Communicate early and often. Know the who, what, when, where and how of communicating with all stakeholders. Know when to use which form of appropriate communication.

Close-out: Always do a lessons learned exercise and get sign-off.

Project management in sum

Project management is as much as toolkit as a methodology and, as such, is a valuable skill for you as an individual as well as for your organization, regardless of whether or not you serve in a formal project management capacity.

The knowledge and experience you gain from working on and managing projects will greatly assist you in both your professional and personal life.

Epilogue
Question/Answer/Comments

Appendix

Acknowledgements

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Graphics