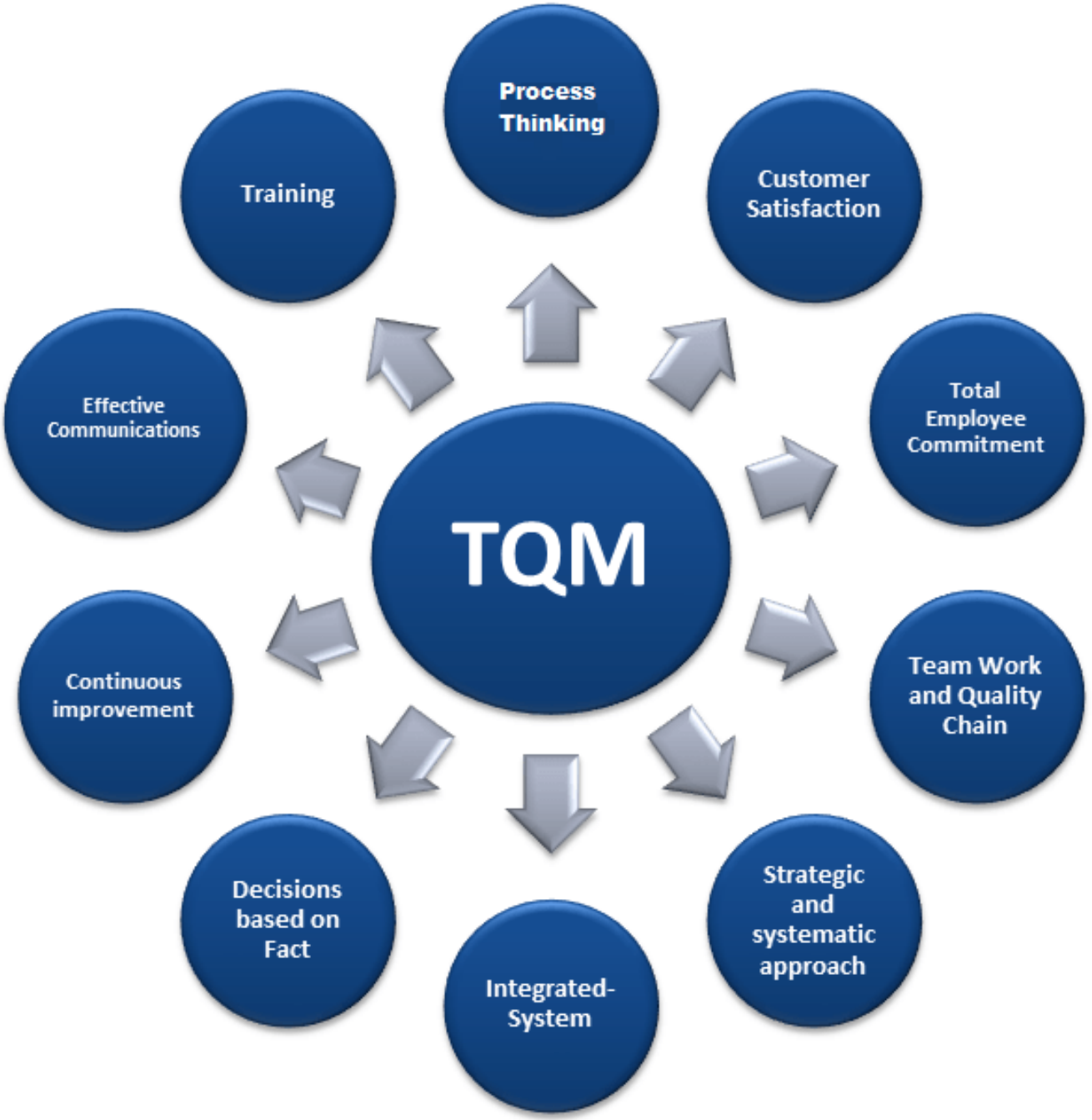
GE8077 Total Quality Management

Total Quality Management (TQM)

- A management approach to long–term success through customer satisfaction.
- Based on the principle that every staff member must be committed to maintaining high standards of work in every aspect of a company's operations.
- In a TQM effort, **all members** of an organization participate in improving processes, products, services, and the culture in which they work.
- They achieve this using **various quality tools.**


TQM
Process Thinking
Customer Satisfaction
Total Employee Commitment
Team Work and Quality Chain
Strategic and systematic approach
Integrated-System
Decisions based on Fact
Continuous improvement
Effective Communications
Training

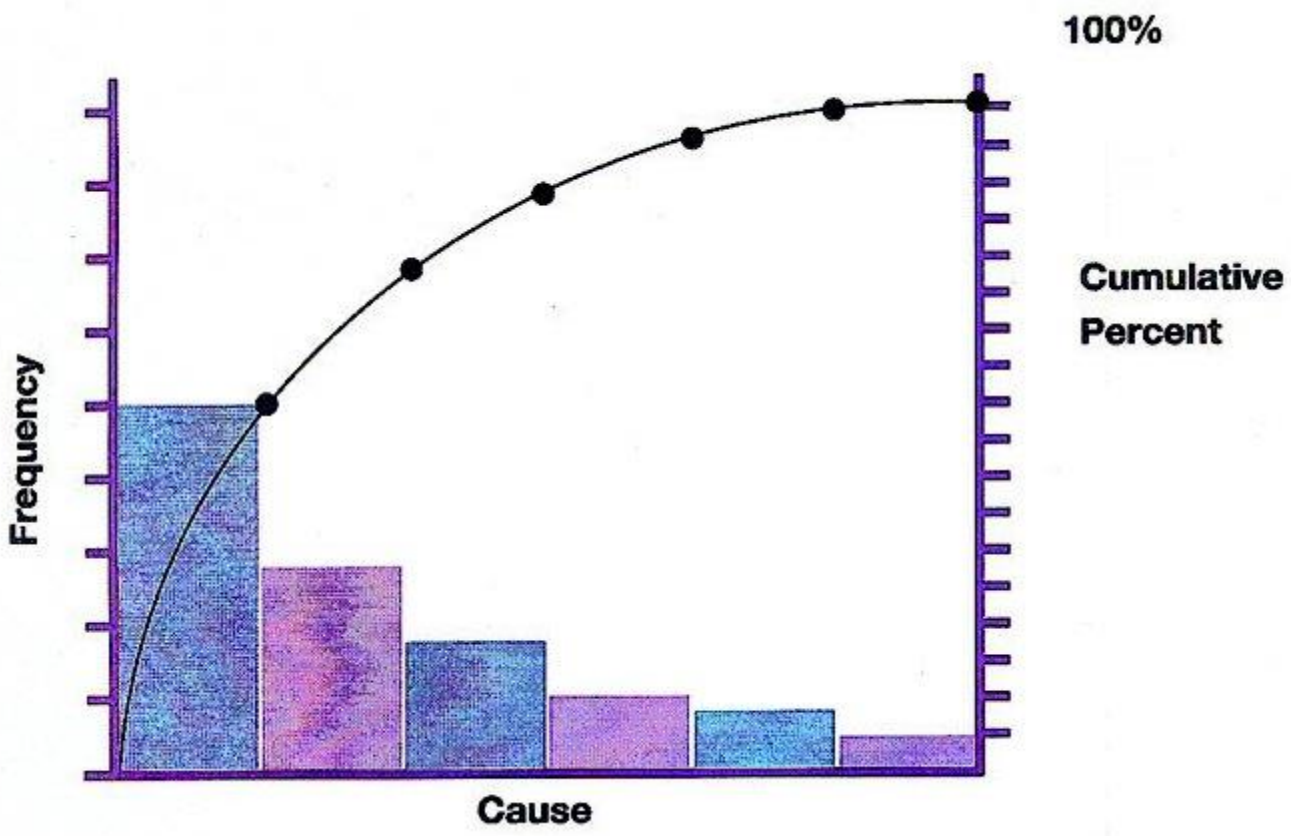
Tools for TQM

Pareto Diagram
Fishbone/Ishikawa Diagram
Check Sheet
Process Flow Diagram
Scatter Diagram
Histogram
Control Chart
Acceptance Sampling
Random Sampling
Reliability
Design of Experiments (DOE)
Process Analysis Tools
Quality Function Deployment
ISO Series
Benchmarking
Total Productive Maintenance
Management and Planning Tools
Lean/Kaizen
Quality Issues
Six Sigma

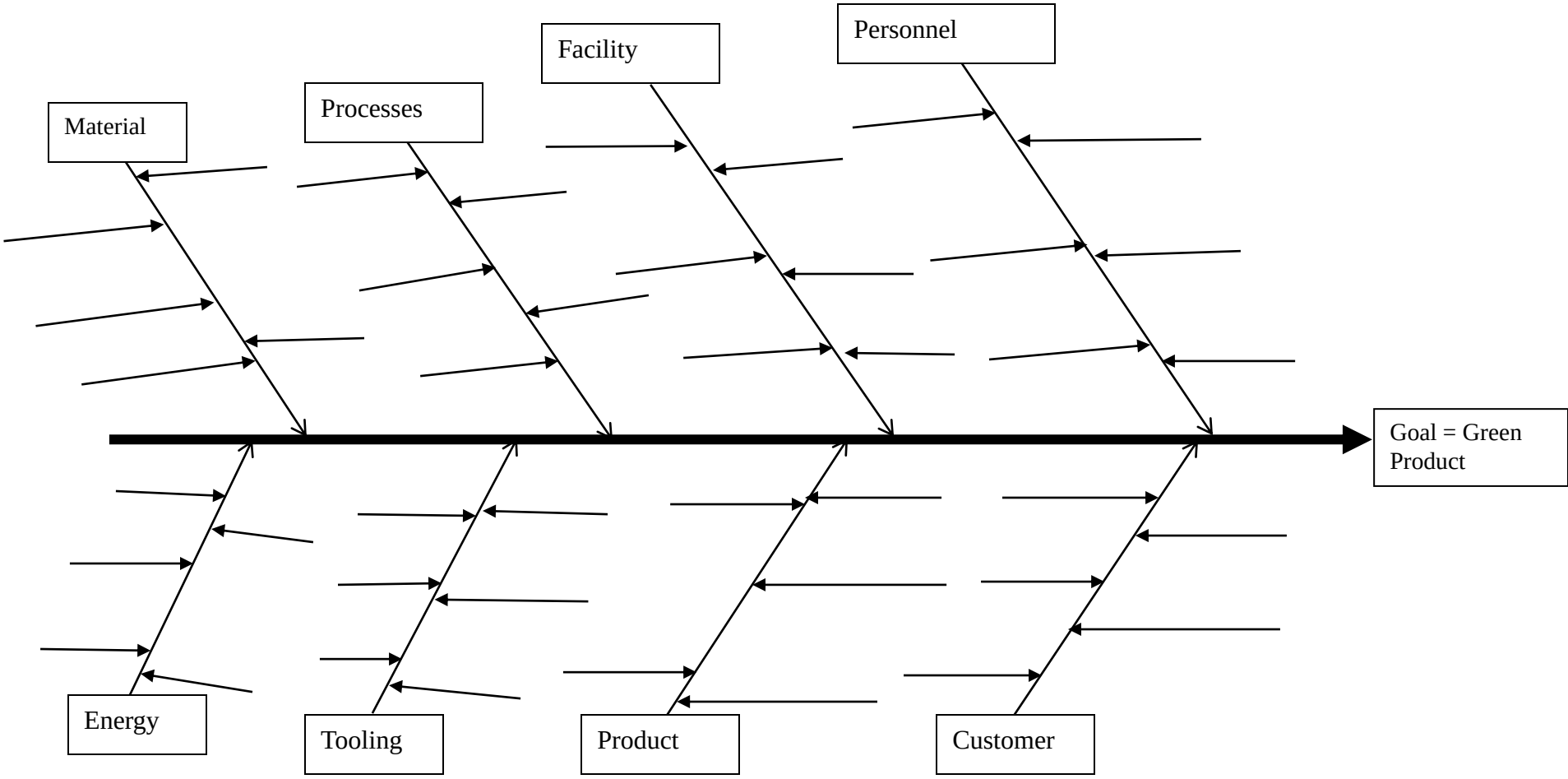
Pareto Diagram

- Named after Vilfredo Pareto
- For vital few, useful many
- In descending order, left to right

Pareto Diagram



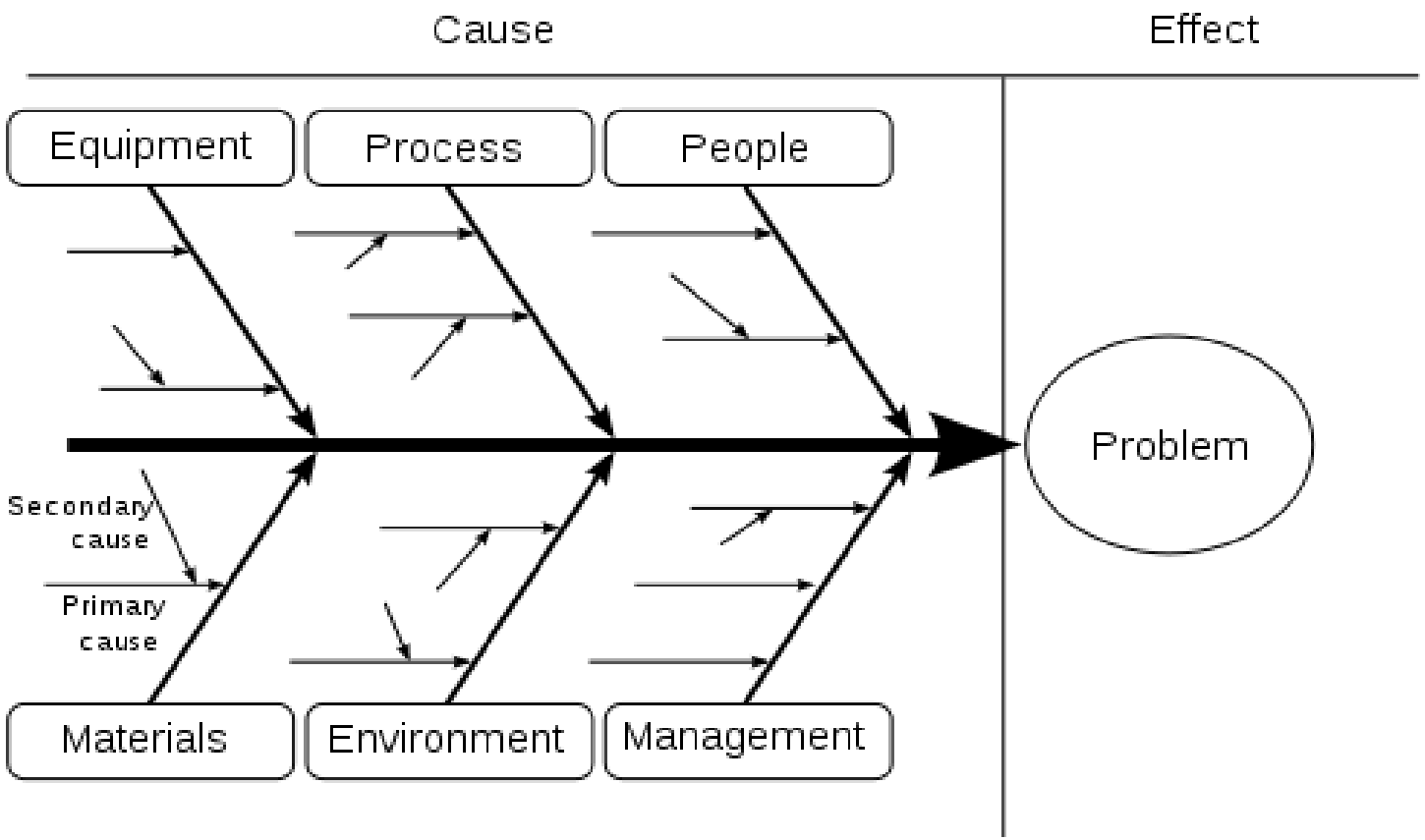
Fishbone Or Cause-and-Effect Diagram



Cause-and-Effect Diagram

- Also called fishbone or Ishikawa diagram
- Helps in tracing cause and effect relationships
- The effect or problem must first be defined or identified
- The effect can be positive or negative

Ishikawa/Fishbone Diagram



Check Sheet

Paint Job Quality Control Checklist

Job: 629555
Inspector: Al Kyder

Problem	Frequency
Chip	𝍸 𝍸 |||
Bubble	|||
Run	𝍸 |
Scrape or scratch	
Inadequate coverage	𝍸 𝍸 𝍸 ||
Other	

Motor Assembly Check Sheet

Name of Data Recorder: Lester B. Rapp

Location: Rochester, New York

Data Collection Dates: 1/17 - 1/23

Defect Types/ Event Occurrence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Supplied parts rusted		|||||||	|||||	||||	||			20
Misaligned weld			|||		||		5
Improper test procedure								0
Wrong part issued								3
Film on parts								0
Voids in casting								6
Incorrect dimensions								2
Adhesive failure								0
Masking insufficient								1
Spray failure			|||||			5
TOTAL		10	13	10	5	4		

Check Sheet

quality-management-tools.com

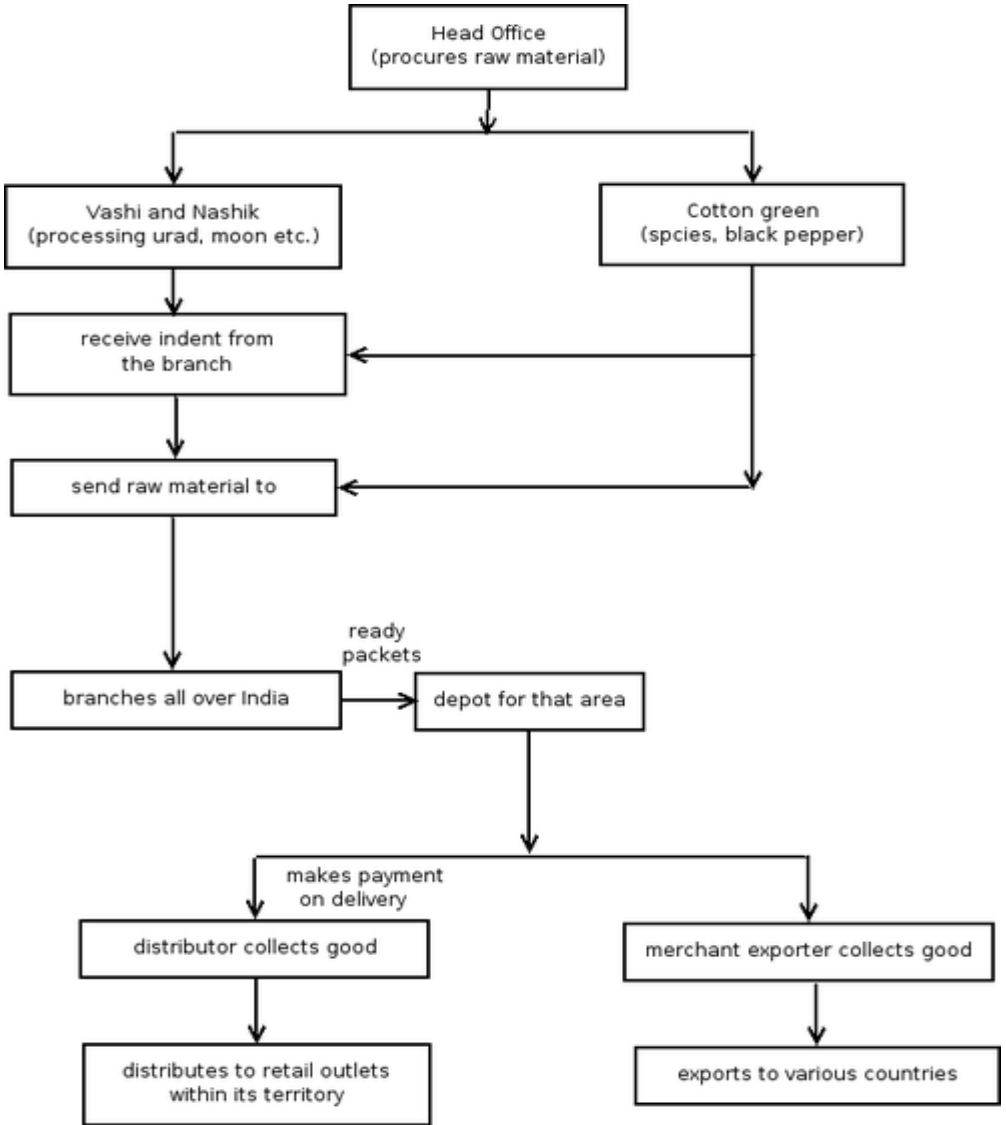
Date: _____

Employee Name: _____

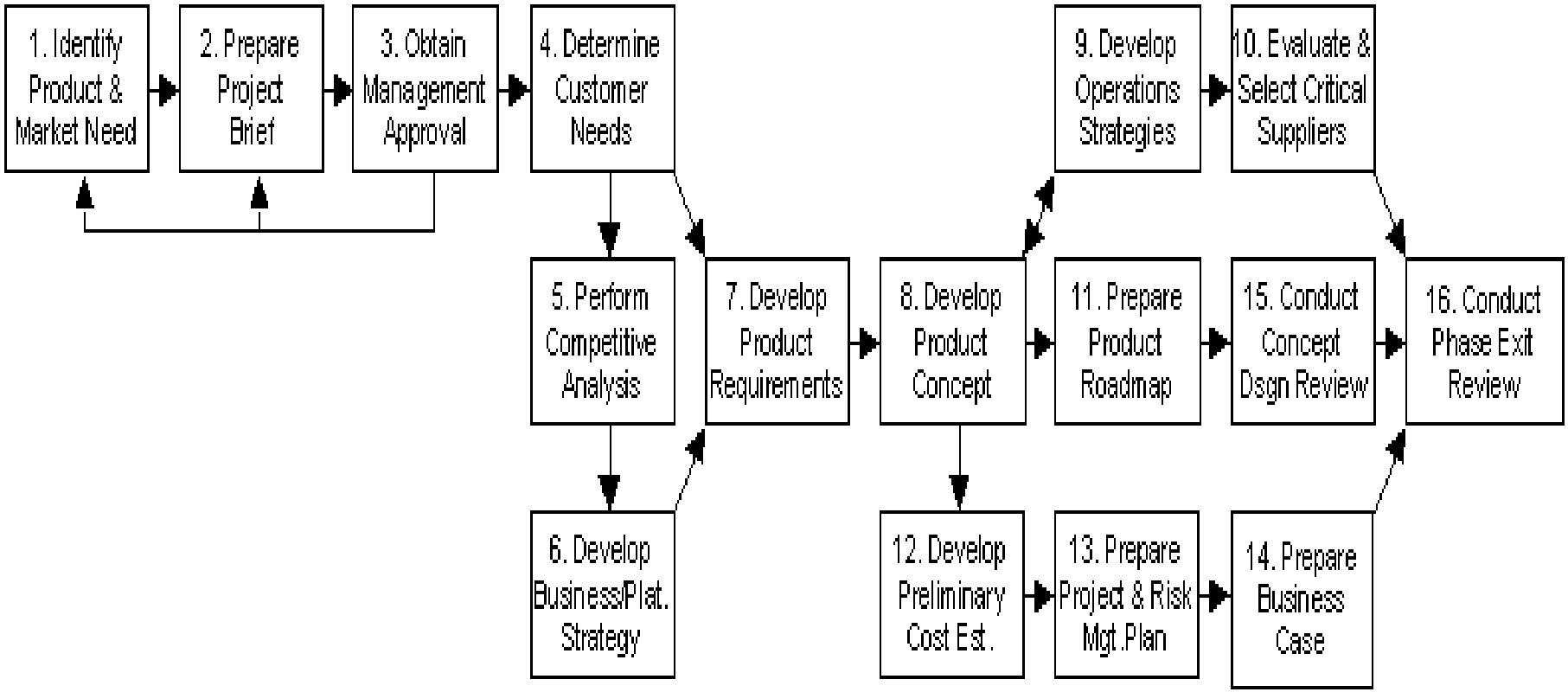
Note: _____

PROBLEM	FREQUENCY
List categories you want to measure such as problems, errors, defects, etc.	Add a check for the appropriate category as you collect your data.
Problem 1	II
Problem 2	III
Problem 3	I
Problem 4	IIII
Problem 5	~~IIII~~ III
Problem 6	~~IIII~~ I
Problem 7	II
Problem 8	I
Problem 9	II
Problem 10	IIII

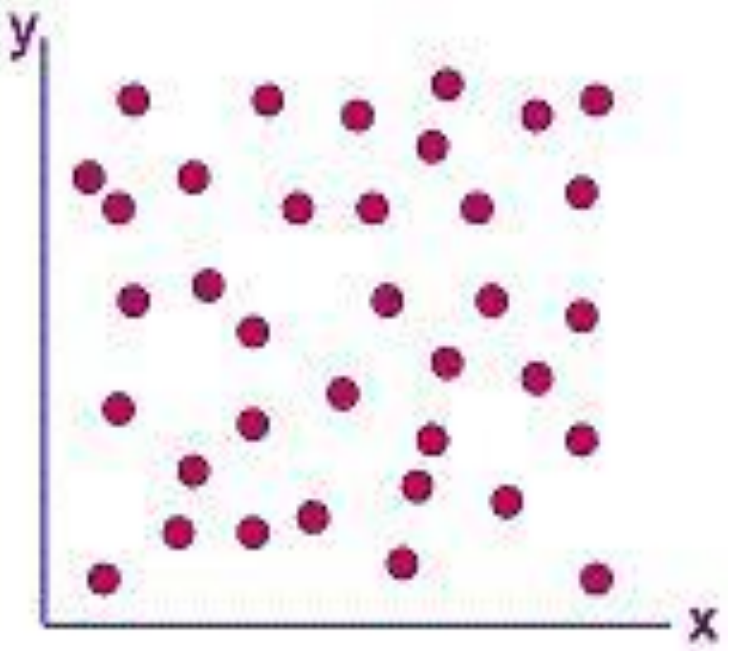
Process Flow Diagram

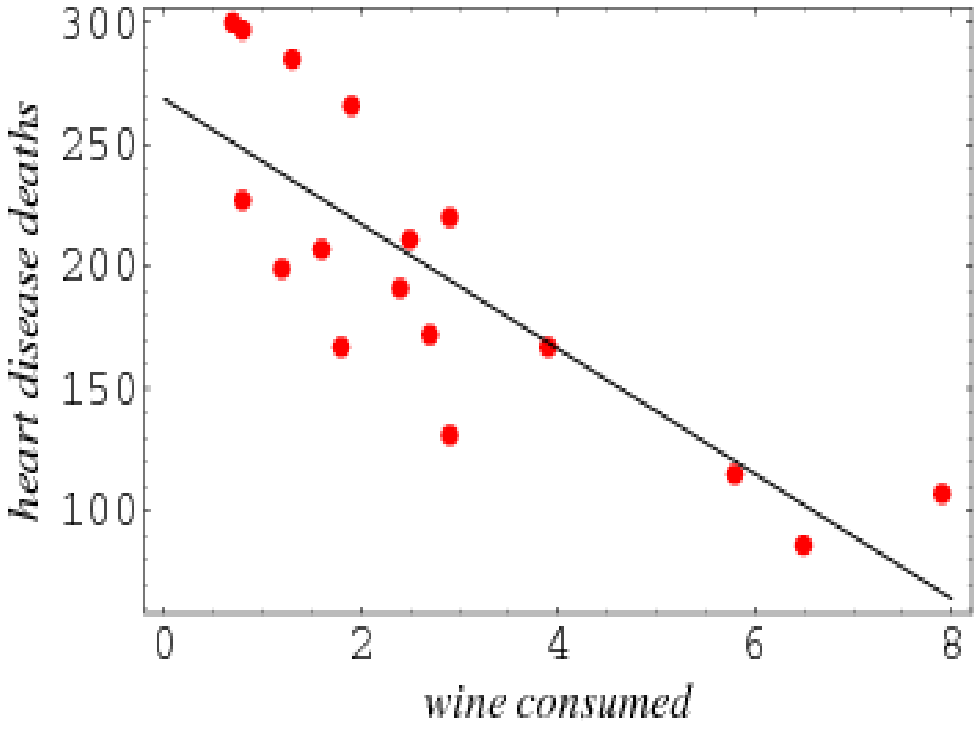


Process Flow Diagram



Scatter Diagram





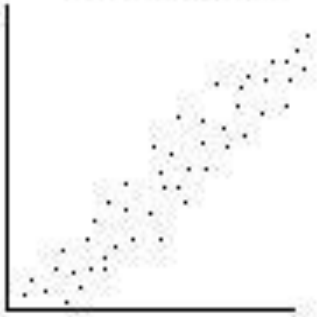
Scatter Diagram Correlation

Strong Negative Correlation

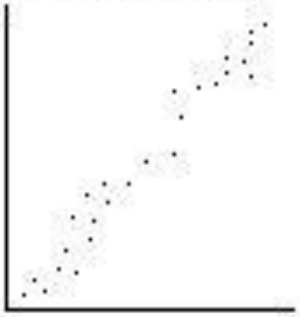
Weak Negative Correlation

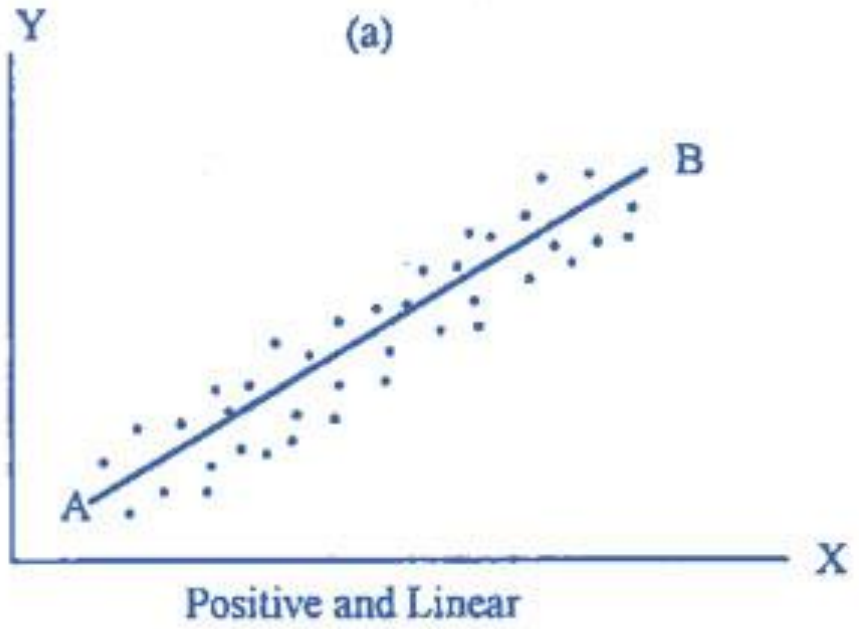
No Correlation

Weak Positive Correlation

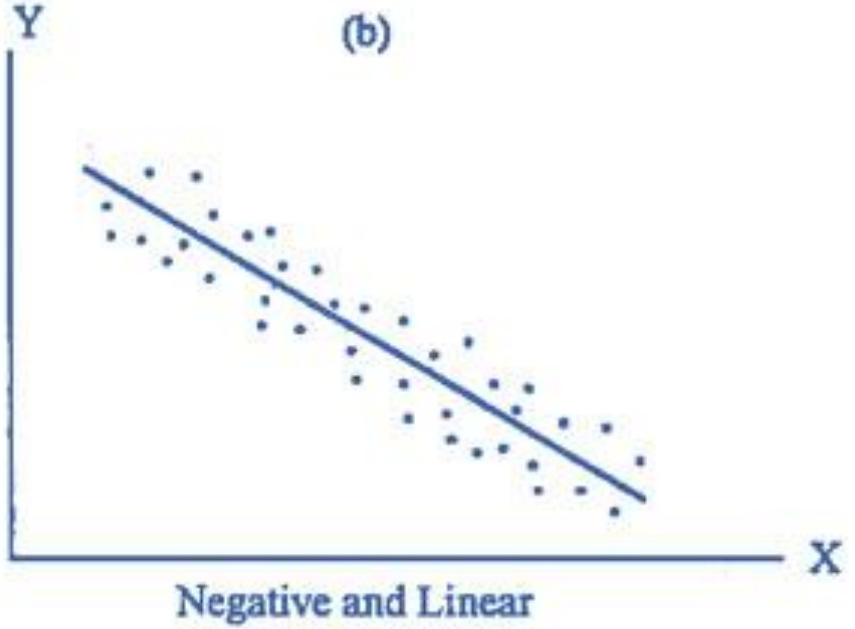


Strong Positive Correlation

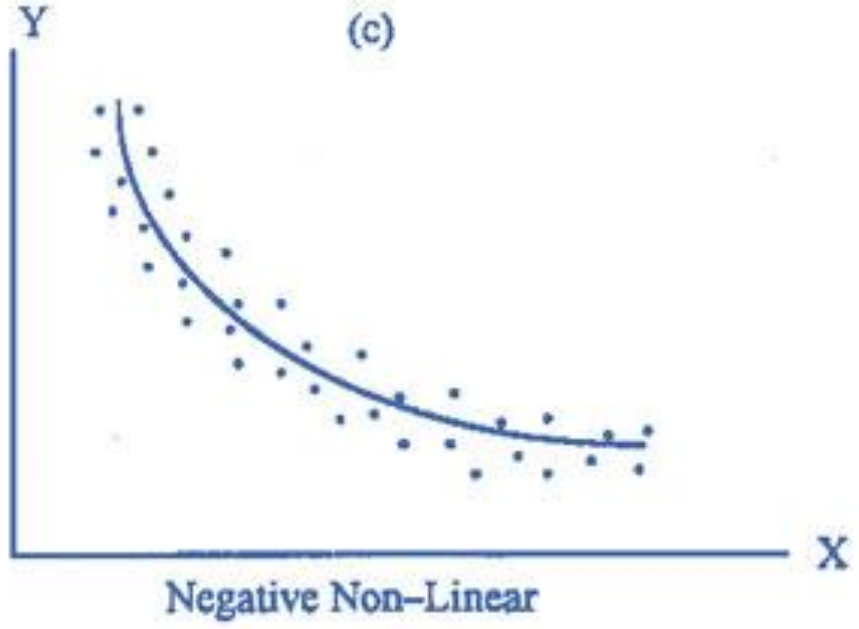




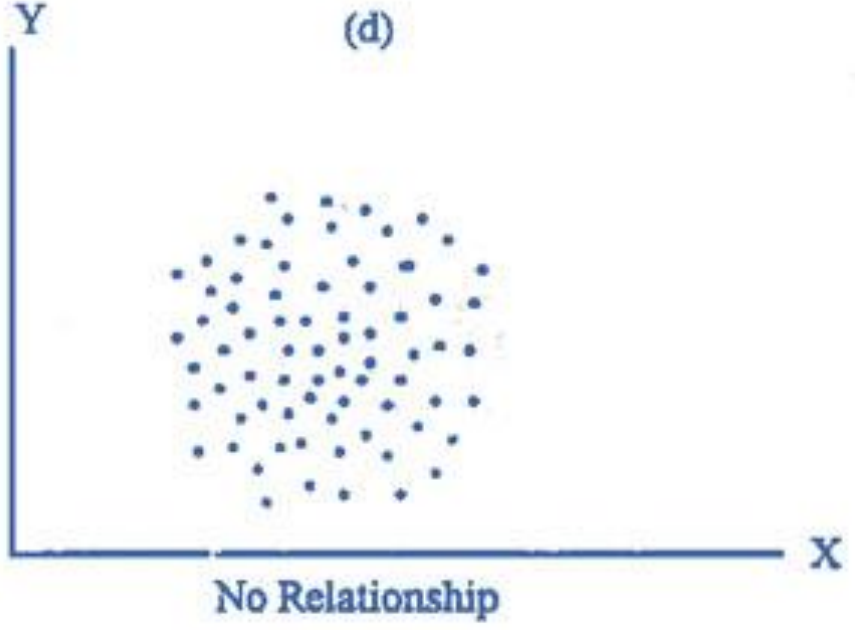
Positive and Linear



Negative and Linear

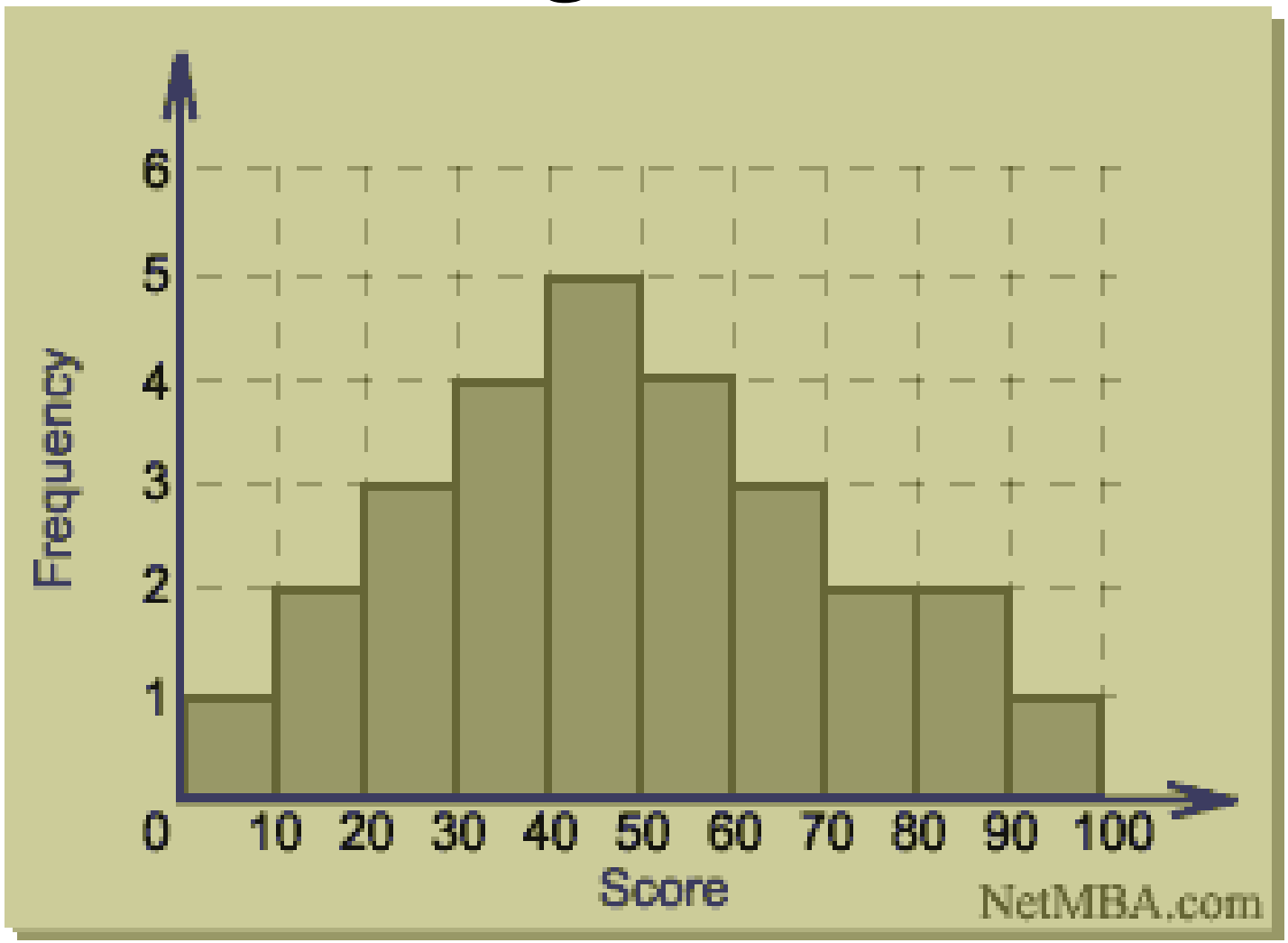


Negative Non–Linear

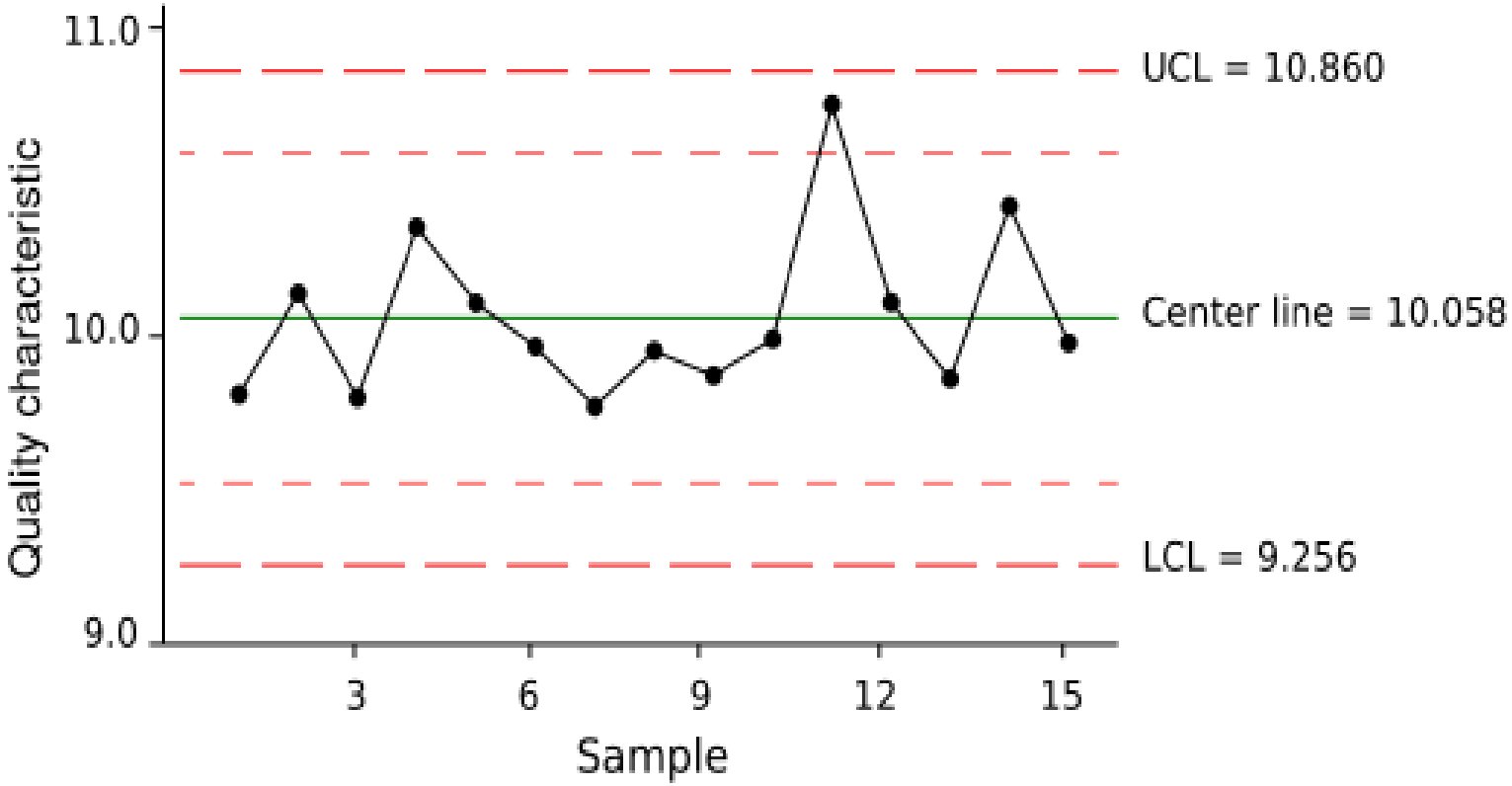


No Relationship

Histogram


Frequency
6
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
100
Score
NetMBA.com

Control Chart



Acceptance Sampling

- A sampling procedure in which a predetermined number (n) is selected from a lot (N) and inspected

- If the number of non-conforming units exceed a certain number, the lot is rejected

Acceptance Sampling

Expressed as: N = 1000; n = 300; c = 3

- N = Lot size
- n = Sample inspected
- c = acceptable defective units

Random Sampling Applied Here

- In random sampling, each item or element of the population has an equal chance of being chosen at each draw

Reliability

- Ability of a product to perform its intended function over a period of time

Design of experiments (DOE)

- Key objective is to determine those variables in a process or product that are critical parameters
- Experiments help to study the effects of those variables

Process Analysis Tool (Process Chart)

PRODUCT NAME:	FLOW BEGINS	FLOW ENDS	DATE

PREPARED BY:	APPROVED BY:

PROCESS SYMBOLS AND NO. USED	**O** OPERATIONS ___ **I** INSPECTIONS ___ **D** DELAYS ___ **T** TRANSPORTATIONS ___ **S** STORAGE ___

TASK NO.	PROCESS SYMBOLS	DESCRIPTION OF TASK	TIME INVOLVED	MACHINE REQUIRED	TOOLING REQUIRED
	O T S I D				

Failure Mode and Effects Analysis (FMEA)

(Source: http://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis)

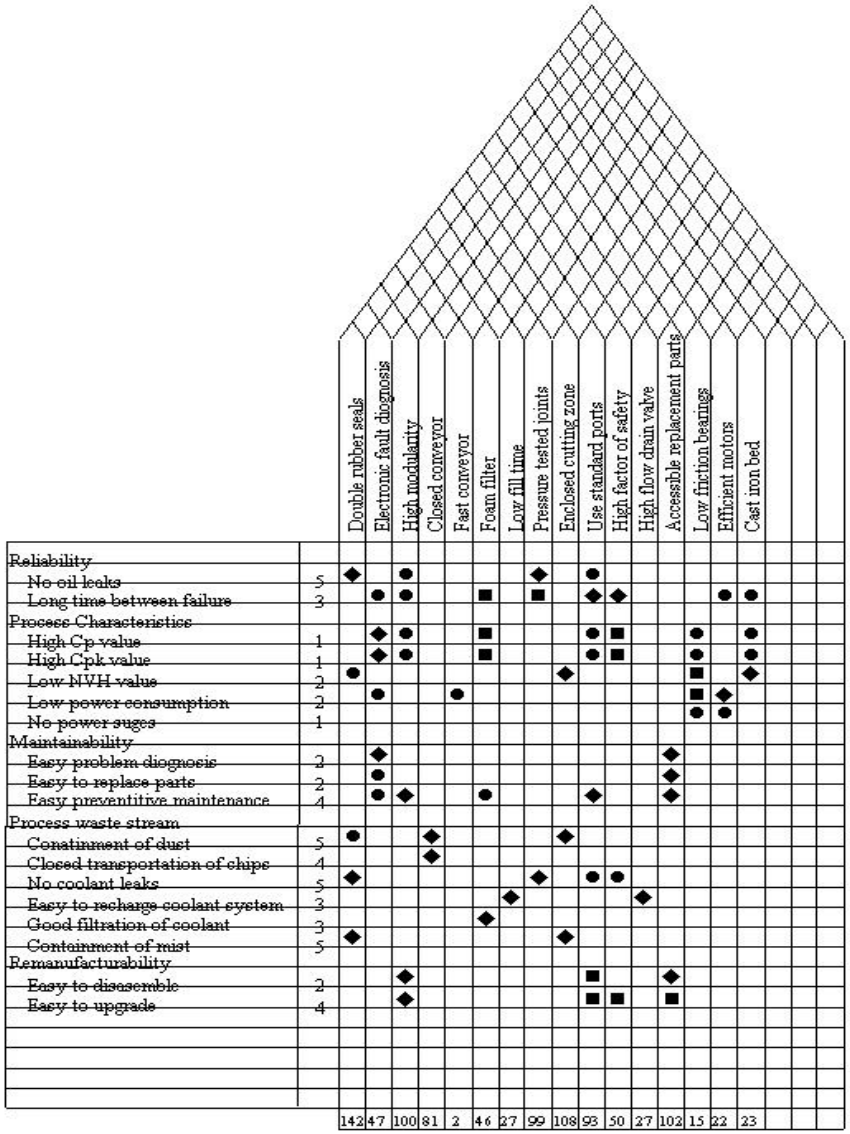
Item / Function	Potential Failure mode	Potential Effects of Failure	S (severity rating)	Potential Cause(s)	O (occurrence rating)	Current controls	D (detection rating)	CRIT (critical characteristic	RPN (risk priority number)	Recommended actions	Responsibility and target completion date	Action taken	New S	New O	New D	New RPN
Fill tub	High level sensor never trips	Liquid spills on customer floor	8	level sensor failed level sensor disconnected	2	Fill time out based on time to fill to low level sensor	5	N	80	Perform cost analysis of adding additional sensor halfway between low and high level sensors	Jane Doe 10-June-2011					

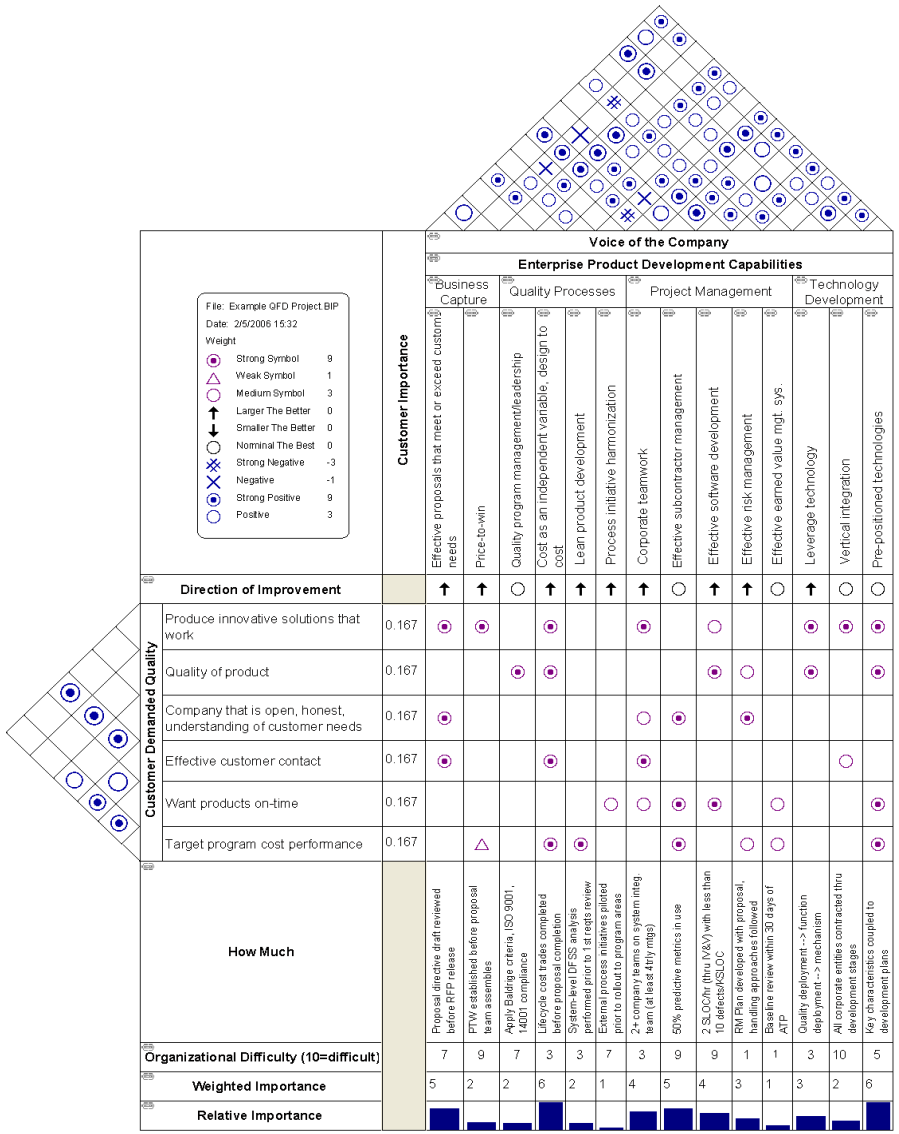
FMEA helps a team to identify potential failure modes based on past experience with similar products or processes, enabling the team to design those failures out of the system with minimum effort and resource expenditure

Quality Function Deployment (QFD)

- Helps transform customer needs into engineering characteristics
- A system that identifies and sets priorities for product, service and process improvement opportunities
- Leads to customer satisfaction

Quality Function Deployment (QFD)





ISO 9000 Series:

- ISO = International Organization for Standards
- ISO 9000 series has three standards:
  1. ISO 9000 covers fundamentals and vocabularies
  2. ISO 9001 is the general requirements
  3. ISO 9004 provides guidance for performance improvement in:
     i. Quality management system (QMS)
     ii. Management responsibility
     iii. Resource management
     iv. Product/service realization
     v. Measurement, analysis, and improvement

ISO 9001:2008

- Is part of the ISO 9000 family of standards, and is the document that lists the requirements an organization must meet to become ISO 9001 Registered.
- Is an internationally recognized Quality Management System.
- ISO 9001 does **NOT** define the actual quality of your product or service.
- The standard helps you achieve consistent results and continually improve the process.
- Thus, if you can make a good product ***most*** of the time, this helps you make it **all** of the time.

What is a Quality Management System?

- A set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization. (i.e. areas that can impact the organization's ability to meet customer requirements.)
- ISO 9001:2008 is an example of a Quality Management System.

ISO 14000

- ISO 14000 is the international standard for environmental management system (EMS)

Top 10 Countries for ISO 9001 Certificates - 2009

Rank	Country	No. of certificates
1	China	257076
2	Italy	130066
3	Japan	68484
4	Spain	59576
5	Russian Federation	53152
6	Germany	47156
7	United Kingdom	41193
8	India	37493
9	USA	28935
10	Korea, Republic of	23400

Benchmarking

The process of measuring products, services, and processes against those of organizations known to be leaders in one or more aspects of their operations

Total Productive Maintenance (TPM)

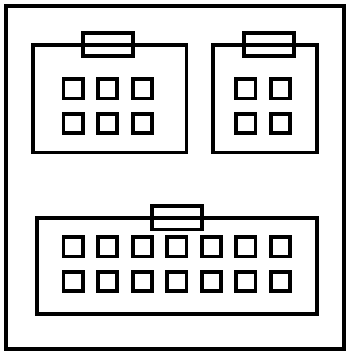
Utilizing the entire workforce to obtain the optimum use of equipment through continuous search to improve maintenance

Management and Planning Tools

- Affinity Diagram
- Interrelationship Diagraph
- Tree Diagram
- Prioritization Matrix
- Matrix Diagram
- Process Decision Program Chart (PDPC)
- Activity Network Diagram

Affinity Diagram

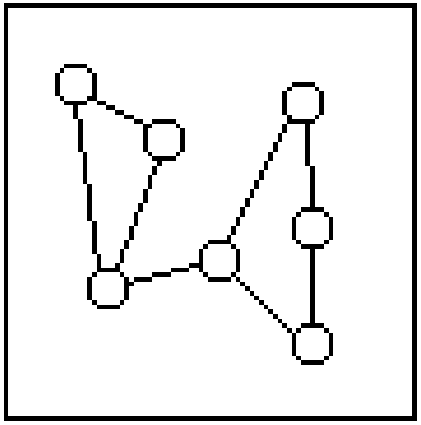
This tool takes large amounts of disorganized data and information and enables one to organize it into groupings based on natural relationships.



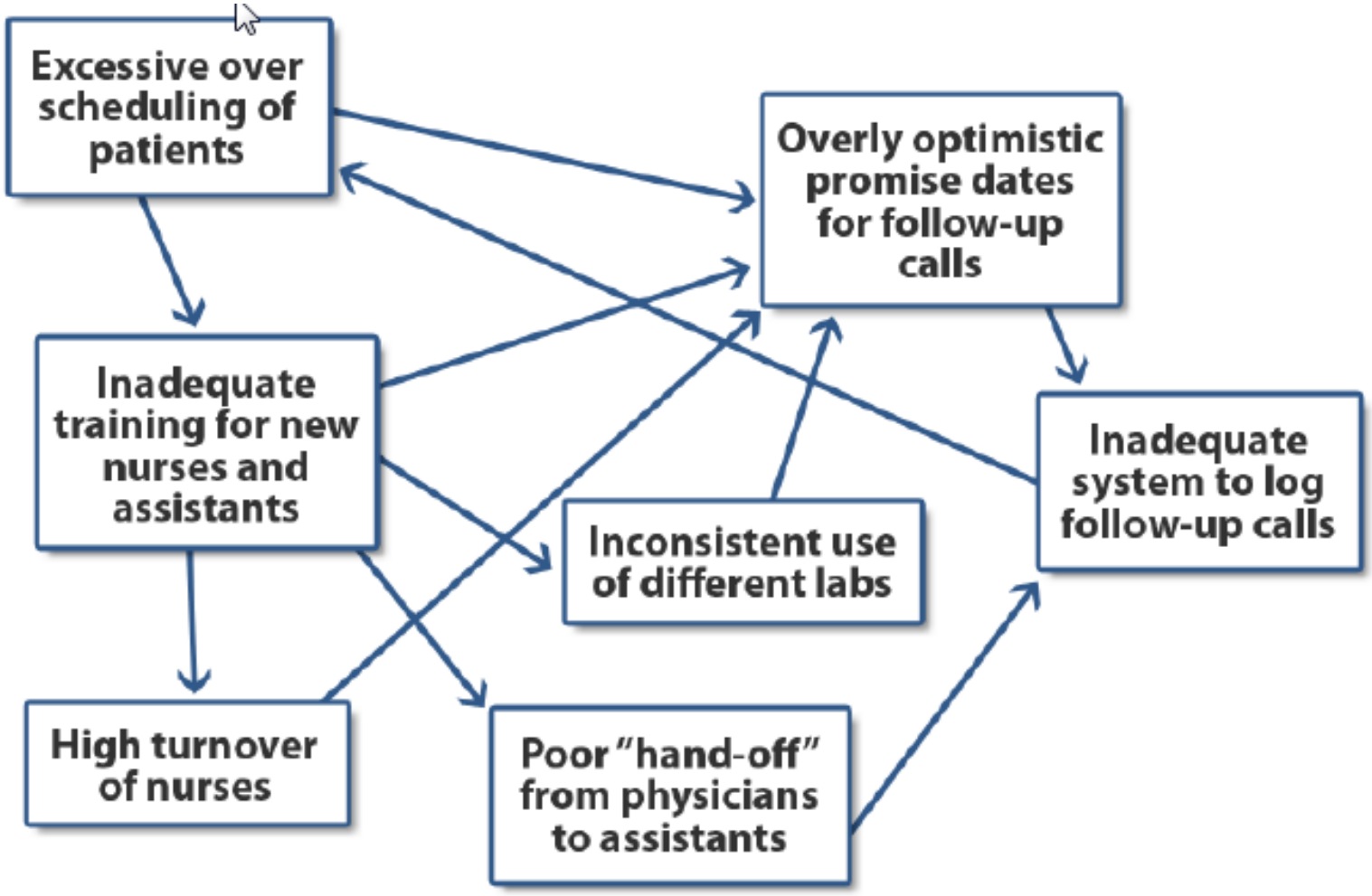
Affinitiy Diagram - Prioritizing Ideas

Interrelationship Digraph

This tool displays all the interrelated cause-and-effect relationships and factors involved in a complex problem and describes desired outcomes.

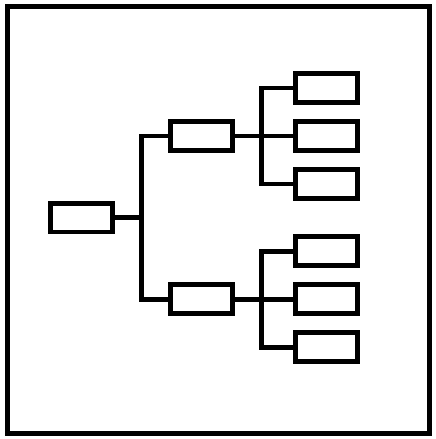


Interrelationship Digraph

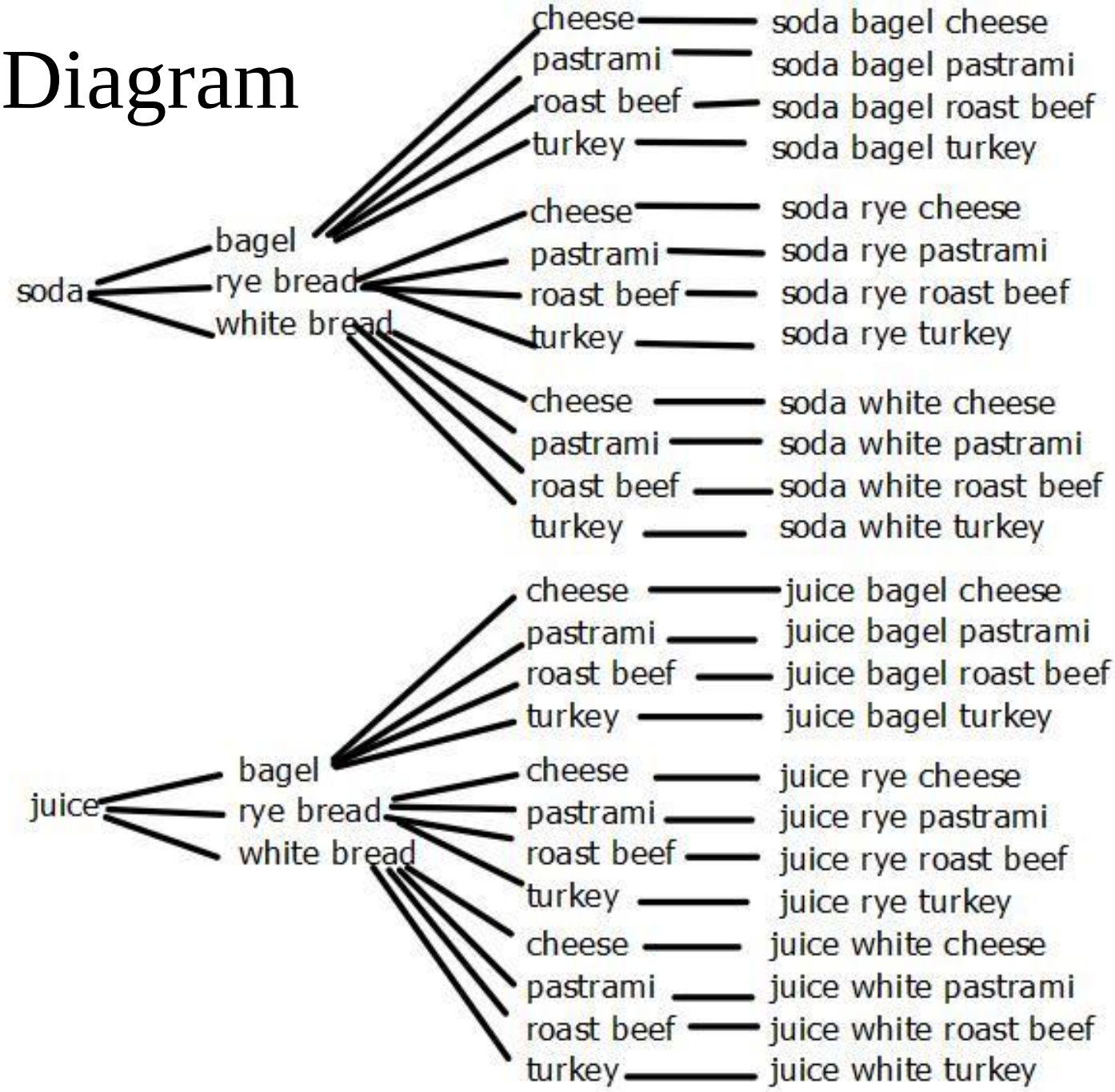


Tree Diagram

This tool is used to break down broad categories into finer and finer levels of detail. It can map levels of details of tasks that are required to accomplish a goal or task.

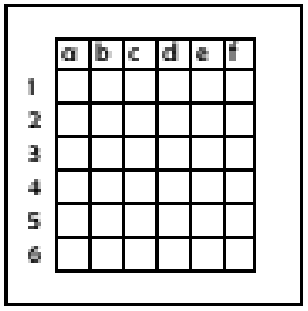


Tree Diagram



Prioritization Matrix

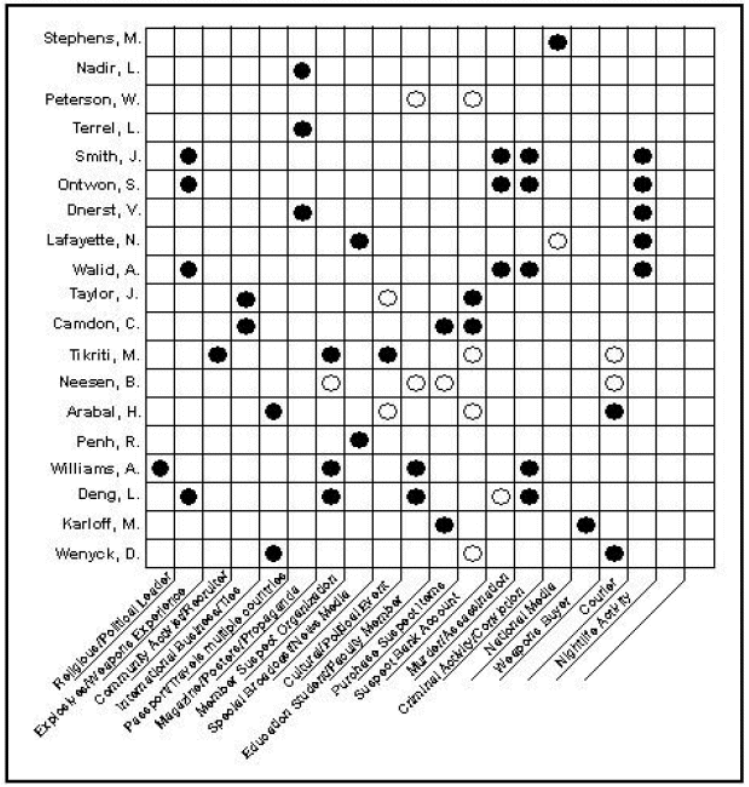
This tool is used to prioritize items and describe them in terms of weighted criteria. It uses a combination of tree and matrix diagramming techniques to do a pair-wise evaluation of items and to narrow down options to the most desired or most effective.




Prioritization Matrix
2
Do Next
1
Do Now
4
Do Never
3
Do Last
High
Low
Importance
Low
High
Urgency

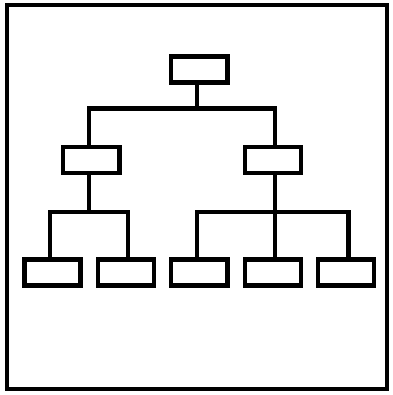
Matrix Diagram

This tool shows the relationship between items. At each intersection a relationship is either absent or present.



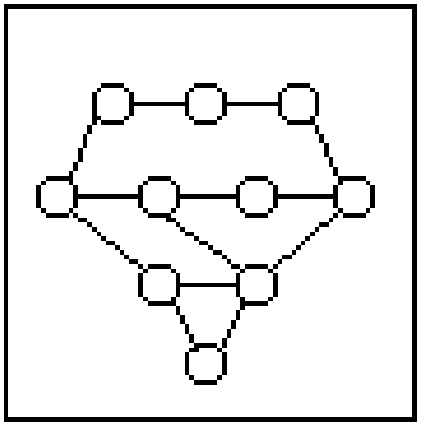
Process Decision Program Chart (PDPC)

A useful way of planning is to break down tasks into a hierarchy, using a Tree Diagram. The PDPC extends the tree diagram a couple of levels to identify risks and countermeasures for the bottom level tasks.

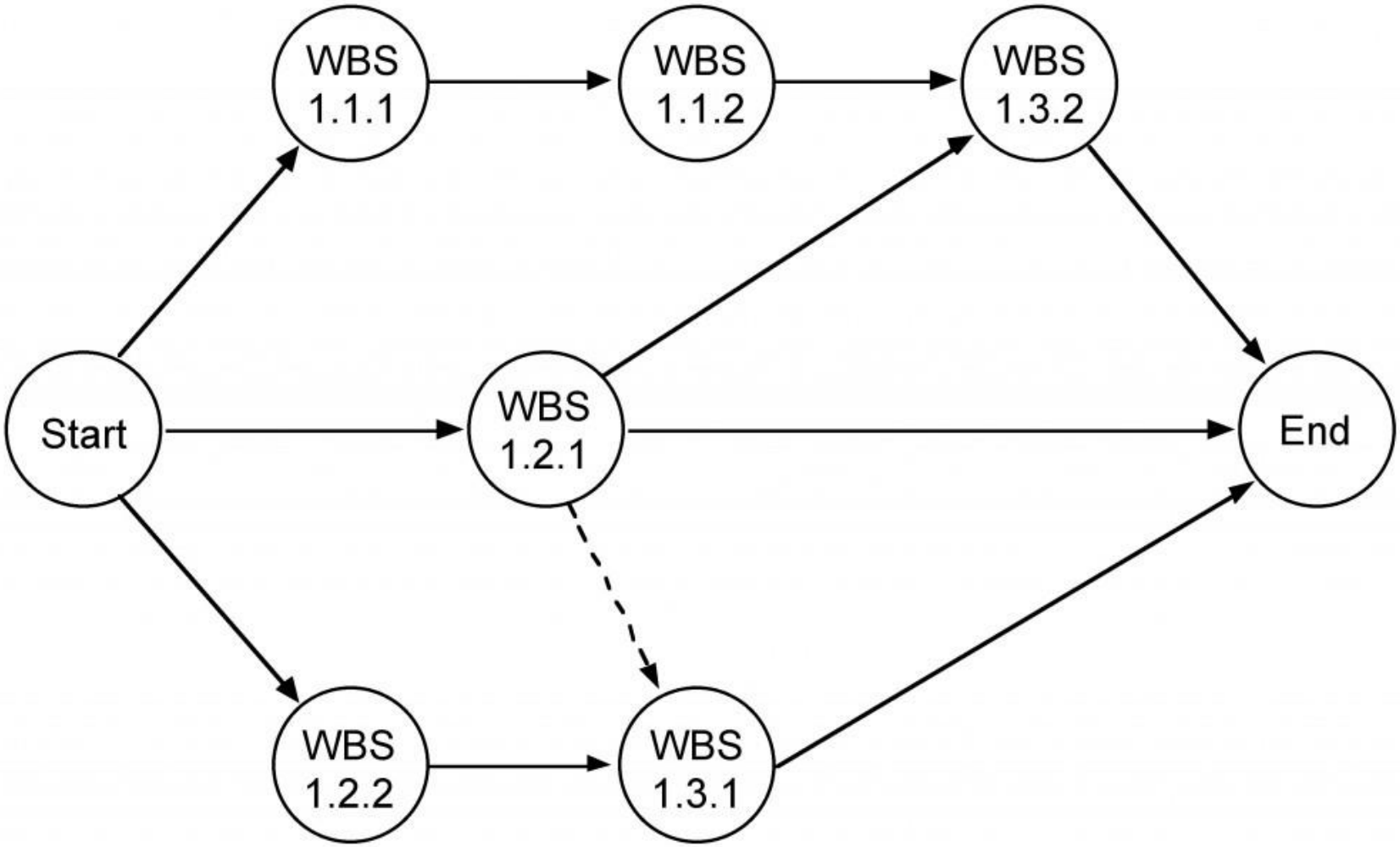


Activity Network Diagram

This tool is used to plan the appropriate sequence or schedule for a set of tasks and related subtasks. It is used when subtasks must occur in parallel. The diagram enables one to determine the critical path (longest sequence of tasks).



Activity Network Diagram



Lean (Kaizen)

- Continuous improvement
- Kaizen is a Japanese word for continuous improvement

Quality Issues

- Identifying quality problems
- Solving quality problems
- Improving quality

To Boost Performance, Quality is Designed into Products as:

- Material
- Function
- Quality characteristics
- Performance
- Reliability
- Features
- Conformance
- Reliability
- Durability
- Service
- Aesthetics
- Reputation
- And more …

Quality is also Designed into the Manufacturing Processes

- Manufacturing processes can be:
  - Procedures
  - Techniques
  - Methods
  - A series of actions that lead to a goal (definition)
    1. Should be specified by engineers who understand them
    2. Can be painstakingly detailed and planned
    3. Should be painstakingly followed, tested and checked
    4. Need trained personnel to understand them
    5. Need trained personnel to execute them
    6. Need appropriate quality tools to execute

Sample Industry Quality Failures

- Ford recalled 1.1M pickups for gas tank problem (August 1, 2011)
- Drug maker Johnson & Johnson cited on quality issues (November 26, 2010)
- Stork Craft Manufacturing, Inc. recalled more than 500,000 baby cribs (2009)
- Toyota recalled multiple models of their vehicles (2009-2011)

Ford to Recall 1.1M Pickups for Gas Tank Problem (August 1, 2011)
Available at:
http://www.lemonauto.com/complaints/1_ford_recalls.htm?gclid=CLrIm6vIsaoCFQQmbAodcFXx8A

Reason for Recall: **Falling off Gas Tanks Due to Rusty Straps**

Ford F-150
Ford F-250
Ford F-350
Ford F-450
Ford F-550
Ford Edge
Lincoln Blackwood
Lincoln MKX

Stork Craft Manufacturing Inc. Recalled More Than 500,000 Baby Cribs (2009)

Reason For Recall:

The mattress support bracket failures create risk of entrapment and suffocation.

Drug Maker Johnson & Johnson Cited on Quality Issues

Reasons for Citation:

- Distribution of drugs that failed quality requirements
- Failure to identify product defects during routine testing
- Failure to detect incorrect expiration dates on drug labels
- Failure to adequately investigate product problems
- Failure to follow laboratory controls and inadequate training of lab staff

Toyota Recalls Failed to Address 'Root Cause' of Many Sudden Acceleration Cases

Toyota Recall Timeline

- First Recall (September 29, 2009): Gas Pedal Entrapment by Floor Mats:
  - 2007-2010 Camry
  - 2005-2010 Avalon
  - 2004-2009 Prius
  - 2005-2010 Tacoma
  - 2007-2010 Tundra
  - 2007-2010 ES 350
  - 2006-2010 IS 250 and IS350
- Recall expanded in January 27, 2010 to include:
  - 2008-2010 Highlander
  - 2009-2010 Corolla
  - 2009-2010 Venza
  - 2009-2010 Matrix
  - 2009-2010 Pontiac Vibe

Second Recall (January 21, 2010): Sticky Gas Pedals

- 2007-2008 Tundra
- 2008-2010 Sequoia
- 2005-2010 Avalon
- 2007-2010 Camry
- 2009-2010 Corolla
- 2009-2010 Matrix
- 2009-2010 RAV4
- 2010 Highlander
- 2009-2010 Pontiac Vibe

Some Implications of Quality Failure

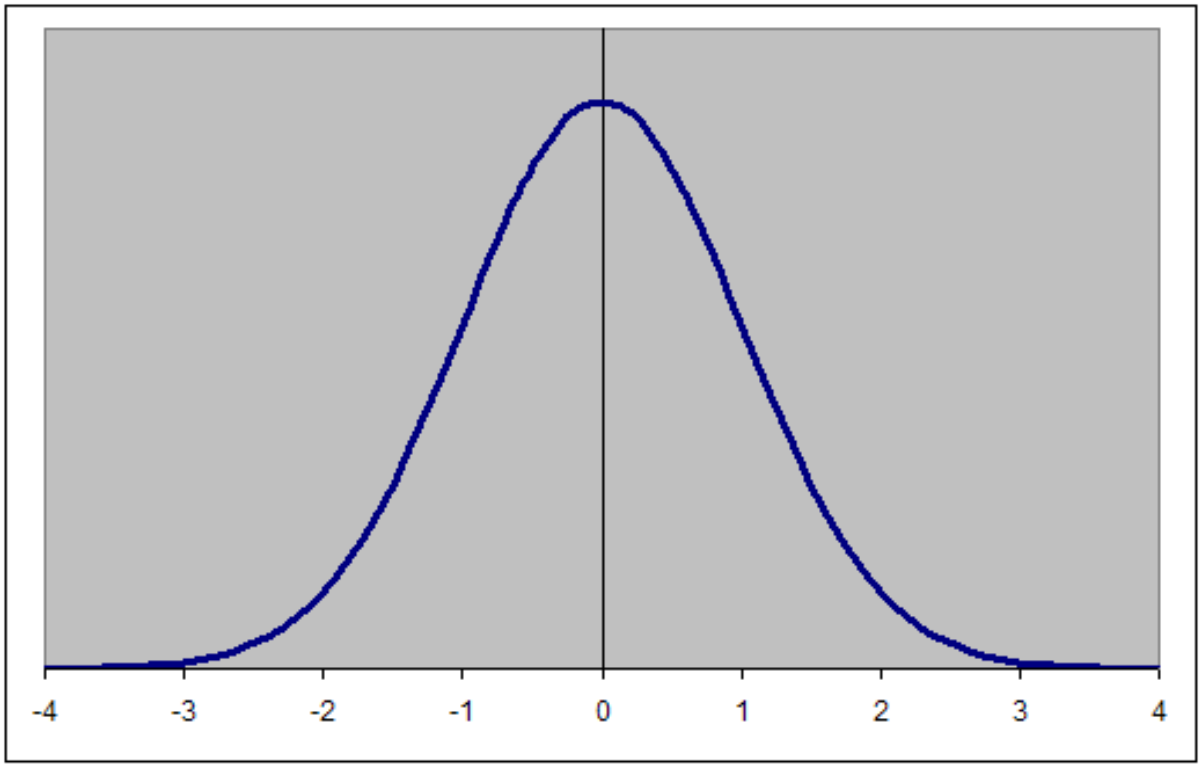
- Lost business
- Lost customers
- Cost of lawsuits
- Damaged public image or reputation
- Cost of repairs
- Cost of scraps
- Cost of quality
- Loss of lives
- Cost due to injuries to customers
- Quality failures can be avoided

Common Quality Practices

- Six Sigma
- ISO 9000 & 14000 series
- TL 9000
- Total quality management (TQM)
- Lean manufacturing
- Statistical process control (SPC)
- Acceptance sampling
- Quality function deployment (QFD)
- Benchmarking
- Total productive maintenance (TPM)
- Design of experiment (DOE)
- Kaizen

Six Sigma

A six sigma process is one in which 99.99966% of the products manufactured are statistically expected to be free of defects (3.4 defects per million).



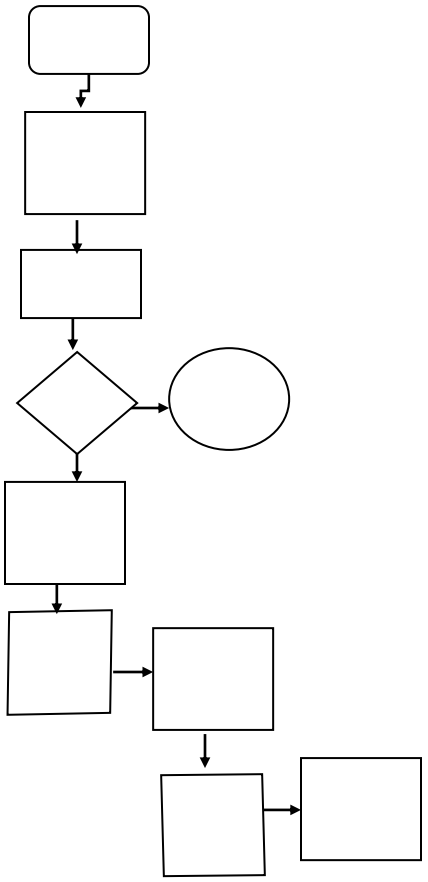
Common Quality Failure Denominators

- Most quality failures could be avoided
- Quality was designed into the products or processes (but)
- Engineers and personnel overlooked something
- Customers (users) risked their lives
- The companies paid a heavy price
- Workers (designers, inspectors, producers) are at the center of it all

Some Reasons for Quality Failures

- Poor design of the product
- Lack of appropriate design in/of the manufacturing processes
- Lack of appropriate control or management of the manufacturing processes
- Lack of appropriately trained personnel to manage the manufacturing processes
- Poor planning and supervision of manufacturing processes
- Lack of worker initiative and responsibility

Simple Process Analysis Tool



Inspect

Mix

Pour

Weigh

Fail

Pass

Ship

Dry

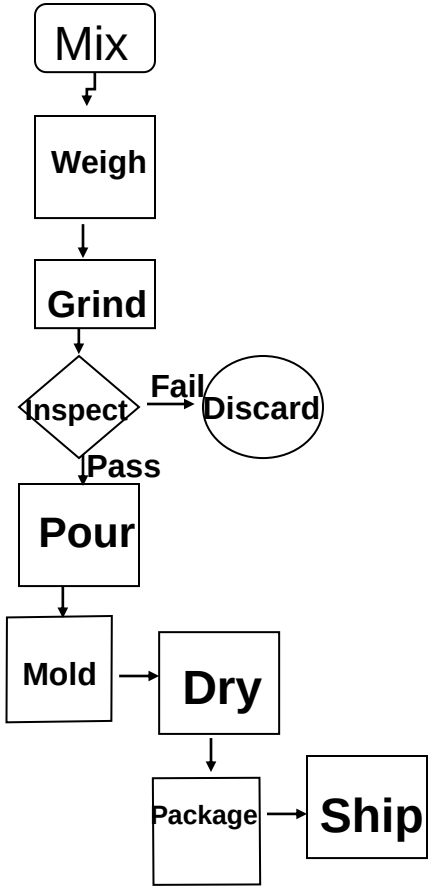
Package

Mold

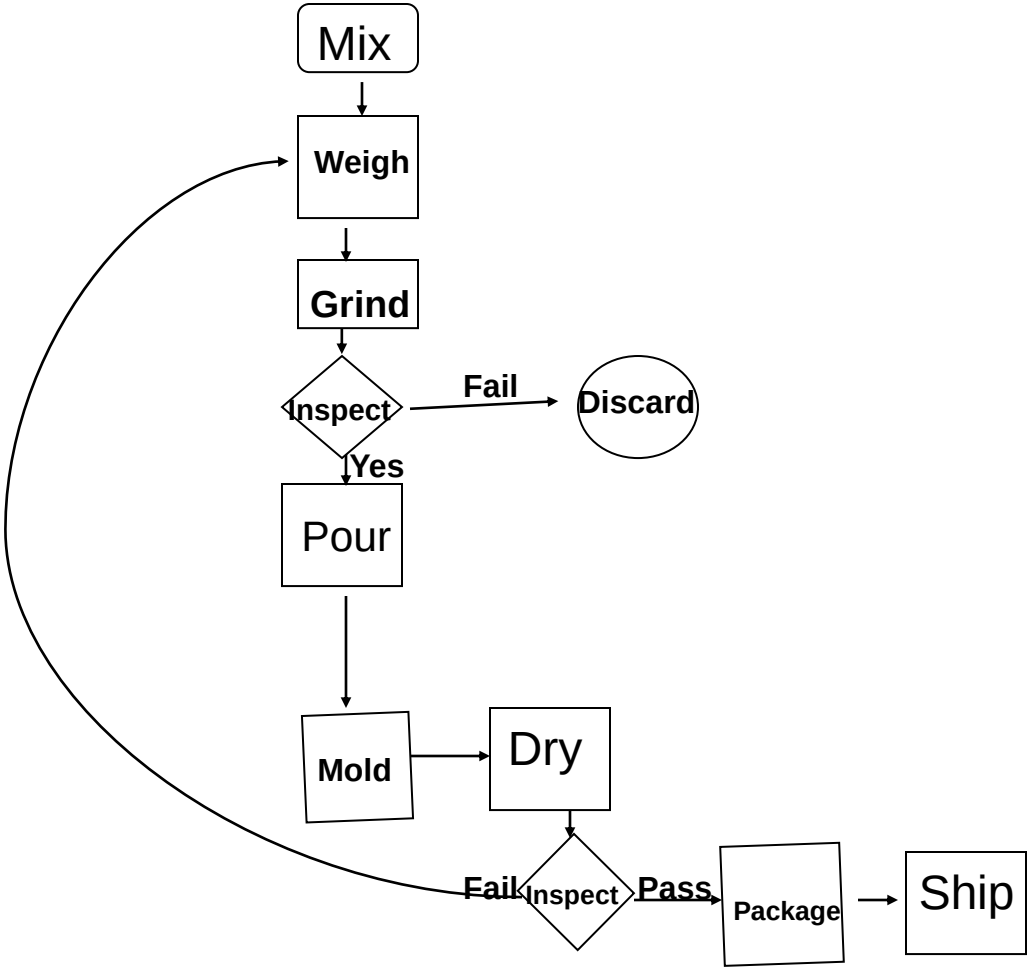
Grind

Discard

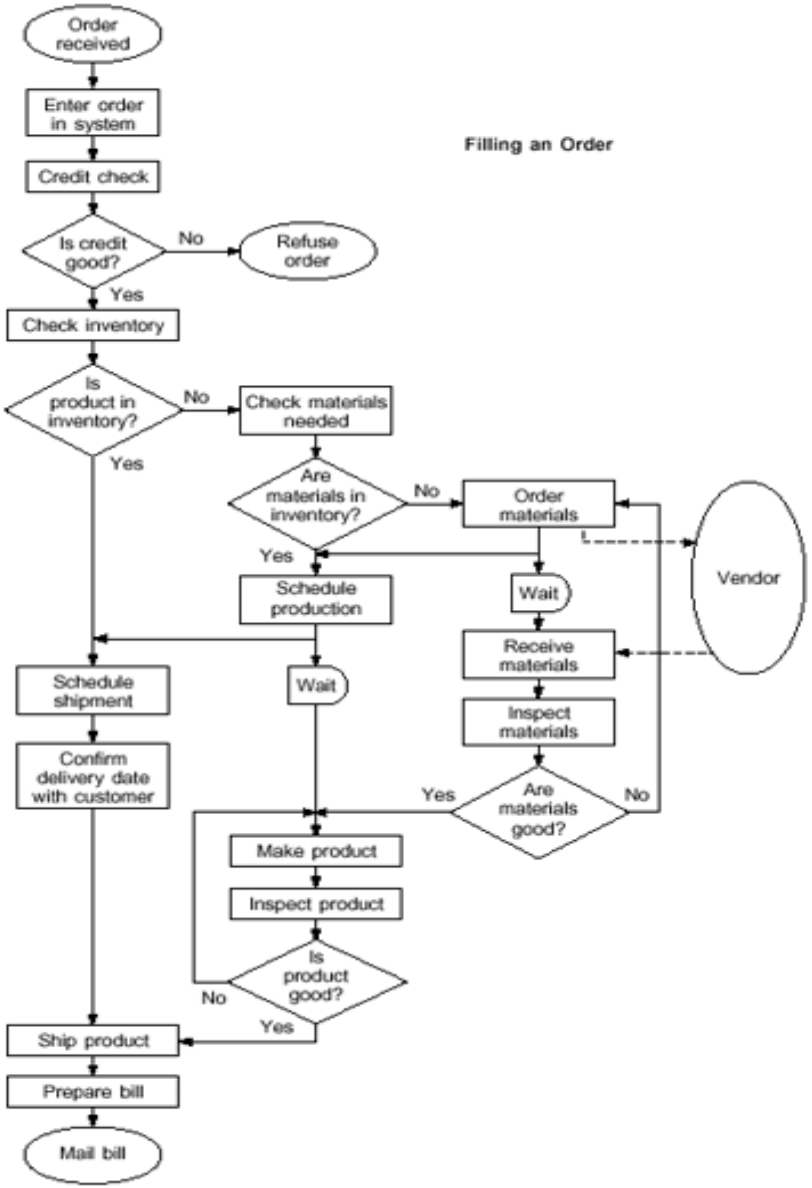
Simple Process Analysis Tool



Simple Process Analysis Tool



Complex Process Analysis Tool



More Inspections Mean:

- More resources will be needed
- Better educated personnel will be needed
- More dedicated personnel will be needed
- More responsible personnel will be needed
- Better and safer products will be produced
- Happier and more satisfied customers

Key Quality Failure Observations

- Quality failures are preventable
- Good quality failure prevention demands comprehensive process/product analysis
- Good full-proof analysis demands trained, knowledgeable and dedicated quality personnel
- Quality improvement efforts should be continuous with dedicated personnel

Areas for Joint Industry-Schools Quality Partnerships

- Qualified quality personnel:
  - Dedication
  - Educated
  - Ethical
  - Fulfillment
- Topics of interest:
  - Designing for quality
  - Prevention of quality failures
  - Providing training for company staff

Thank You