

Monitoring & Quality Control Systems

IEN 131

1st semester

By
Dr.Gomaa Ahmed Abdelrazek

2025

IEN 131 Monitoring & quality control systems

1 Cr . hrs = { 1 lect + 0 tut +0 lab }

Introduction , history of quality , the dimensions of quality , quality control concepts**(1)** , quality assurance , total quality management , control systems , objectives of control systems**(2)** , quality systems , top management communicating , hazard analysis , high-quality , recommendations**(3)** , commitment monitoring , follow up systems , the base of the hazard analysis critical point (HACCP) **(4)** , sampling and inspections , sample size , sampling error , sampling design and inspection **(5)** , acceptance sampling plans , quality control tools and techniques , tools for creating new concepts**(6)** , tools for organizations and analysis of data , tools for determine and solving problems (control charts for variables – control charts for attributes – PRE - control – analysis – flow charts) **(7)** , international standards accreditation meaning , ISO requirements and recommendations**(8)** , audit program , certifications body , analyzing process capability indices , process performance indices **(9)** .

غص 131 تودجلاطبض و تبقارملا مظن

[illegible]

Textbook :

- Besterfield , D, QUALITY CONTROL , Prentive hall , Englwood NJ . USA 6TH Ed . 2000

References :

- Henning Kagermann , et , all , Internal audit handbook , Springer – Verlag Berlin Heidelberg 2008 .
- Oakland J.S. , total quality management , Butterworth – Heinemann , Oxford , 2nd Ed 2000

Assessment :

Final exam: 70% , year work 30%

Contents

No	Title	Page
	CHAPTRR.1:	
1.1	Introduction , history of quality , the dimensions of quality , quality control concepts ,quality assurance	11
1.2	Total quality management , control systems , objectives of control systems ,quality systems.	16
1.3	Top management communicating , hazard analysis , high-quality , recommendations	24
	CHAPTRR.2	
2.1	Commitment monitoring , follow up systems , the base of the hazard analysis critical point (HACCP)	25
2.2	Sampling and inspections , sample size , sampling error , sampling design and inspection	47
2.3	Acceptance sampling plans , quality control tools and techniques , tools for creating new concepts	79
	CHAPTRR.3	
3.1	Tools for organizations and analysis of data , tools for determine and solving problems (control charts for variables – control charts for attributes – PRE - control – analysis – flow charts)	92
3.2	International standards accreditation meaning , ISO requirements and recommendations	99
3.3	Audit program , certifications body , analyzing process capability indices , process performance indices	104

Course outline

Definitions of Quality

History of Quality

Concepts of Quality

1. Definitions:

- Quality.
- Quality Control.
- Quality Assurance.
- Total Quality Management (TQM).

2. Philosophies and Views of the Quality Gurus.

- Dr. W. Edward Deming.
- DR. JOSEPH JURAN.
- PHILIP CROSBY.
- DR. WALTER SHEWHART.

1. **Part I:** Quality definitions and concepts:

* Definitions of Quality.
* Concepts of Quality.

2. **Part II:** Control charts for variables:

* Control charts techniques.
* State of control.
* Specifications.

Definitions of Quality

Quality is often used for many different meanings:

1. Fitness for use, “Juran”.
2. Conformance to specifications, “Crosby”.
3. Zero defects , “Crosby”.
4. Customer satisfaction.
5. Doing things right the first time.

ISO Definitions of Quality

- The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs.



History of Quality Assurance :

- Skilled craftsmanship during Middle Ages
- Industrial Revolution: rise of inspection and separate quality departments
- Statistical methods at Bell System (Inspection Department)
- Quality control during World War II (Resource Shortages)
- Quality management in Japan (Kaizen)
- Quality awareness in U.S. manufacturing industry during 1980s: "Total Quality Management" (CBS VP Quote: Hanged)
- Malcolm Baldrige National Quality Award (1987)
- Quality in service industries, government, health care, and education
- Current and future challenge: Keep progress in quality management alive
- "Quality is Free" ~Philip Crosby

Dimensions of Quality



Dimensions of Quality

- **Performance**:

  Will the product perform its intended job? customer usually evaluates a product to determine if it will perform certain specific functions and determine how it will perform them.

- **Reliability**:

  The product will function as expected without failure. How often does the product fail? Products will usually require some repair over their service life. For example, you should expect that an automobile will require occasional repair, but if the car requires frequent repair, we say that it is unreliable.

- **Durability**:

  The expected operational life of the product; How long does the product last? This is the effective service life of the product. Customers obviously want product that perform satisfactorily over a long period of time.

- **Serviceability**:

  How easy is it to repair the product? There are many industries in which the customer's view of quality is directly influenced by how quickly and economically a repair or routine maintenance activity can be accomplished.

- **Aesthetics**:

  What does the product look like? This is the visual appeal of the product, often taking into account factors such as style, color, shape, packaging alternatives, tactile characteristics, and other sensory features.

- **Features**:

  What will the product do beyond the basics? Usually customers associate high quality with products that have added features; that is, those that have features beyond the basic performance of the competition.

- **Perceived Quality:**

  What is the reputation of the company selling this product? In many cases, customers rely on the past reputation of the company concerning quality of its products. This reputation is directly influenced by failures of the product, and by how the customer is treated when reported a defect product.

- **Conformance to standards:**

  Is the product made exactly as the designer intended? We usually think of high quality product as exactly meets the world requirements.

WHATISQUALITY..?

- It is the degree to which a set of inherent characteristics fulfills requirements"Fitness for use"

§Quality is excellence that is better than a minimum standard.

§"Conformance to requirements"

§The ability of product or service to satisfy

MEANING OF CONTROL

Control is a system for measuring and checking (inspecting) a phenomenon. It suggests when to inspect, how often to inspect and how much to inspect. In addition, it incorporates a feedback mechanism which explores the causes of poor quality and takes corrective action.

Control differs from 'inspection', as it ascertains quality characteristics of an item, compares the same with prescribed quality standards and separates defective items from non-defective ones. Inspection, however, does not involve any mechanism to take corrective action.

quality control concepts :

Quality Control is a systematic control of various factors that affect the quality of the product. The various factors include material, tools, machines, type of labour, working conditions, measuring instruments, etc. Quality Control can be defined as the entire collection of activities which ensures that the operation will produce the optimum Quality products at minimum cost.

Total Quality Control is: "***An effective system for integrating the quality development, Quality maintenance and Quality improvement efforts of the various groups in an organization, so as to enable production and services at the most economical levels which allow full customer satisfaction"***

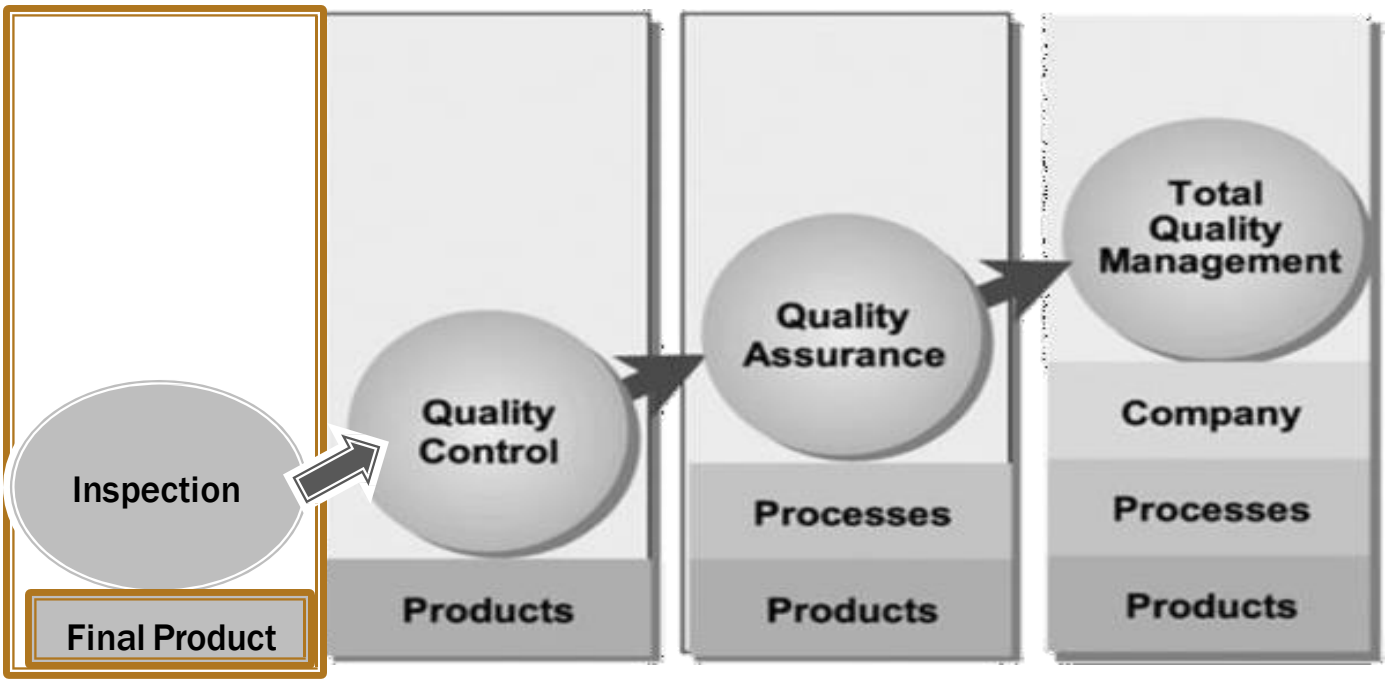
Quality Intervals

Four Intervals :

Quality Developed through four intervals

There are Four-level model of the evolution of total quality management;

- Inspection,
- Quality Control,
- Quality Assurance,
- Total Quality Management.



1. Inspection

- Measure the characteristics of a product and compare them with its specifications; The goal here is the fitness of standards.
- This is the passive "inspecting" attitude.
- Inspection is carried out by a trained separated persons.

Quality Control

- Inspection performed by the workers themselves with a feedback loop to the production line; Here we avoid the "inspector" effect and allow some learning to take place.
- Quality control includes all techniques and activities of an organization that continuously monitor and improve the conformance of products, processes to specifications.
- Quality control focused on process output.

Process Control and Improvement

Process refers to certain unique combinations of machines, tools, methods, materials, and people engaged in production. Process control and improvement9 connotes a set of methodological and behavioral practices, which are implemented to control and improve processes that produce products and services (Juran and Gryna, 1993). In fact, process control and improvement can make the manufacturing process operate as expected, without breakdowns, missing materials, fixtures, tools, etc., and despite workforce variability (Flynn et al., 1994). A set of practices of process control and improvement is described in the following paragraphs

ADVANTAGES OF QUALITY CONTROL

- Quality of product is improved which in turn increases sales.
- Scrap rejection and rework are minimized thus reducing wastage.

So the cost of manufacturing reduces.

- Good quality product improves reputation.
- Inspection cost reduces to a great extent.
- Uniformity in quality can be achieved.
- Improvement in manufacturer and consumer relations.

Quality Assurance

- Quality assurance describes all the planned and systematic actions necessary to assure that a product or service will satisfy the specified requirements.
- It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention.
- Two principles included in quality assurance are: "Fit for purpose" (the product should be suitable for the intended purpose); and "right first time" (mistakes should be eliminated).
- QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes.

In the words of Alford and Beatly, ***"Quality Control" may be broadly defined as that "Industrial management technique means of which products of uniform accepted quality are manufactured." Quality Control is concerned with making things right rather than discovering and rejecting those made wrong.***

In short, we can say that quality control is a technique of management for achieving required standards of products.

Quality System Improvement

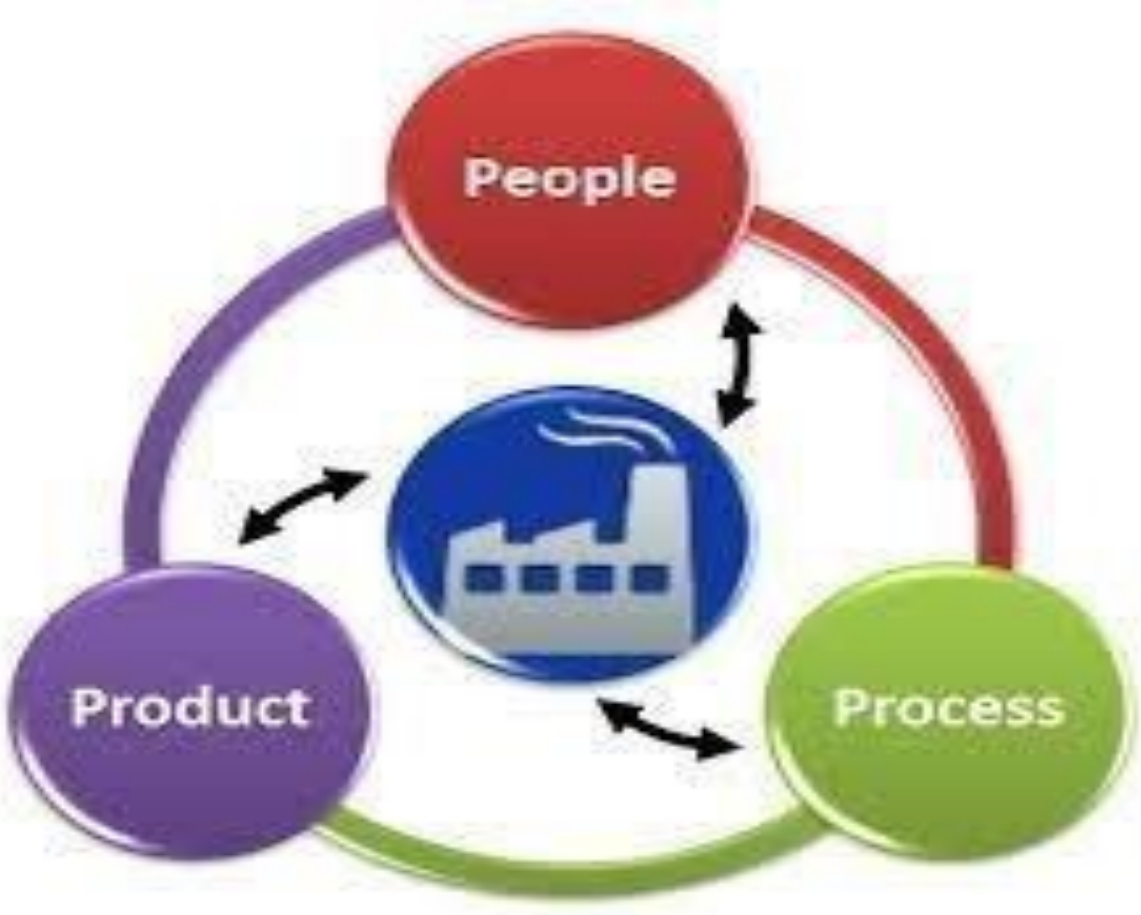
Quality system is defined as the organizational structure, procedures, processes and resources needed to implement quality management (ISO 8402, 1994). In 1987, the International Standardization Organization published the ISO 9000 standards series on quality management and quality assurance. Implementing ISO 9000 is a way in pursuing quality system improvement in a firm. In this study, quality system improvement means to establish a quality system according to the requirements of ISO 9000.

Quality Management

-Quality management is the means of implementing and carrying out quality policy.

- Quality management is responsible for seeing that all quality goals and objectives are implemented and that corrective actions have been achieved

.



1.2 Total Quality Management



• TQM is a strategy for continuously improving performance at every level, and in all areas of responsibility. It combines fundamental management techniques, existing improvement efforts, and specialized technical tools under a disciplined structure focused on continuously improving all processes. Improved performance is directed at satisfying such broad goals as cost, quality, schedule, and mission need and suitability.

• Total Quality Management means management centered on quality and based on the participation of everybody which aims at the customer satisfaction and at the improvement of the company's personnel, of the company and of the society.

• Total Quality Management is defined as a strategy for improving business performance through the commitment and involvement of all employees to fully satisfying customer requirements, at the optimum overall costs, through the continuous improvement of the products and services, business processes and people involved.

Quality in service organizations

- Defining quality in manufacturing organizations is often different from that of services. Manufacturing organizations produce a tangible product that can be seen, touched, and directly measured and usually focus on tangible product features. Examples: cars, clothes, computers, and food.
- The most common quality definition in manufacturing is conformance, performance, features. It is easy to see how different customers can have different definitions in mind when they speak of high product quality.

- In contrast to manufacturing, service organizations produce a product that is intangible.
- Usually, the complete product cannot be seen or touched. Rather, it is experienced.
- Examples include delivery of health care, experience of staying at a vacation resort, and learning at a university.
- Intangible nature of the product makes defining quality difficult.
- Also, since a service is experienced, perceptions can be highly subjective. In addition to tangible factors, quality of services is often defined by perceptual factors.
- These include responsiveness to customer needs, courtesy and friendliness of staff, promptness in resolving complaints, and atmosphere.
- Other definitions of quality in services include:

➢ Time: the amount of time a customer has to wait for the service.

➢ Consistency: the degree to which the service is the same each time.

For these reasons, defining quality in services can be especially challenging.

- Comparison between dimensions of quality for manufacturing and service organizations are shown in Table:

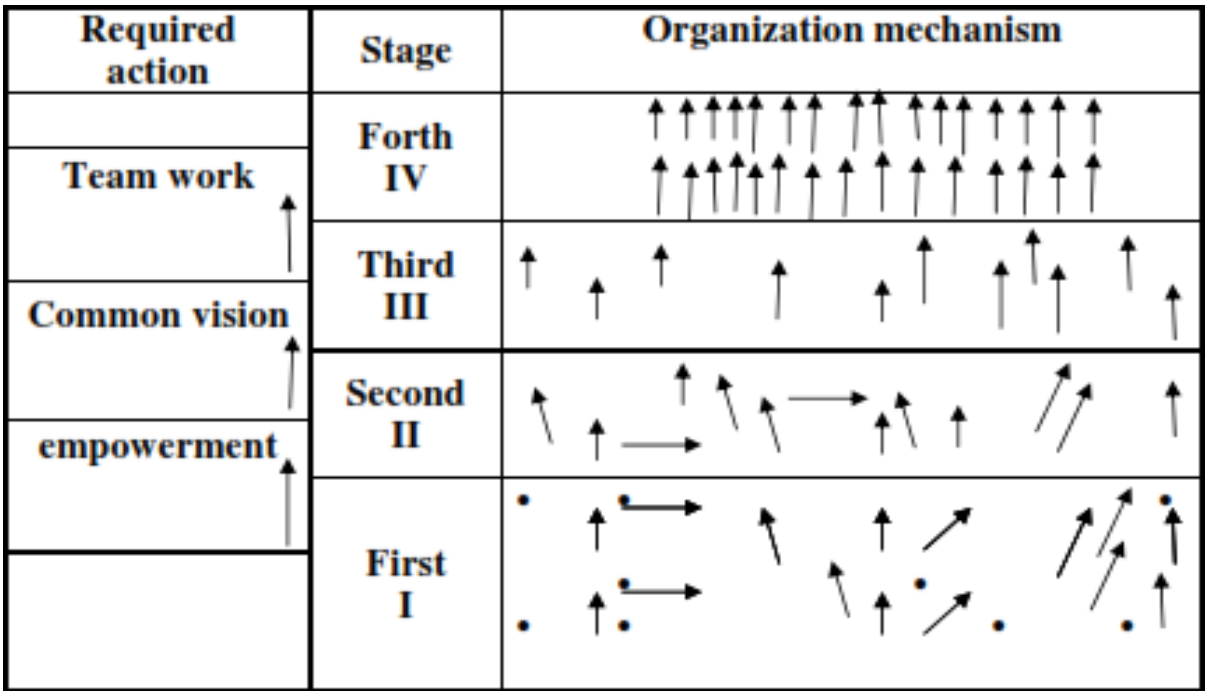
Manufacturing Organizations	Service Organizations
Conformance to specifications	Intangible factors
Performance	Consistency
Reliability	Responsiveness to customer needs
Features	Courtesy/ friendliness
Durability	Timeliness / promptness
Serviceability	Atmosphere

TQM Six Basic Concepts

1. Leadership
2. Customer Satisfaction
3. Employee Involvement
4. Continuous Process Improvement
5. Supplier Partnership
6. Performance Measures

(All these present an excellent way to run a business)

Model of different stages of achieving TQM in organization



Different stages of development in TQM

1. First stage:

There are few people constantly work, while there are several others are relax by doing minimum work, that I not good for organization.

2. Second stage:

No one is relaxing but the people work in different directions, that is mean that no single focus and goal for the organization.

3. Third stage:

The people work in the same directions, which indicate that there are common goal and vision for the organization, and everyone is motivated to the same vision.

4. Forth stage:

All people are working as a team, the resultant effects are five times greater than the effect when people working as a group. The input is the same but the output increase five times.

•When the organization is in stage four, then implementation of TQM will be effective.

Comparison bet. the basic concept of Quality in the past and now

	Quality in the past	Quality now
1	Product quality is the key	Customer requirement is the key
2	Focus on Product	Focus on business tasks
3	Corrective action were followed	Preventive action are followed
4	Responsibility with quality department	Responsibility with all employee
5	Quality was a function	Quality is a strategy
6	Result is important	Process is important
7	Mainly the system was focused	Both system and human component are focused
8	Quality considered to be a tool	Quality is process philosophy

-A quality system:

• is a mechanism that coordinates and maintains the activities needed to ensure that the characteristics of products, processes or services are within certain bounds.

•A quality system involves every part of an organization that directly or indirectly affects these activities.

FACTORS AFFECTING QUALITY

In addition to **men, materials, machines and manufacturing conditions** there are some other factors which affect the product quality. These are:

- Market Research i.e. in-depth into demands of purchaser.
- Money i.e. capability to invest.
- Management i.e. Management policies for quality level.
- Production methods and product design.

Modern quality control begins with an evaluation of the customer's requirements and has a part to play at every stage from goods manufactured right through sales to a customer, who remains satisfied.

Objectives of quality control systems:

OBJECTIVES OF QUALITY CONTROL

- To decide about the standard of quality of a product that is easily acceptable to the customer and at the same time this standard should be economical to maintain.
- To take different measures to improve the standard of quality of product.
- To take various steps to solve any kind of deviations in the quality of the product during manufacturing.

FUNCTIONS OF QUALITY CONTROL DEPARTMENT

- Only the products of uniform and standard quality are allowed to be sold.
- To suggest method and ways to prevent the manufacturing difficulties.
- To reject the defective goods so that the products of poor quality may not reach to the customers.
- To find out the points where the control is breaking down and to investigate the causes of it.
- To correct the rejected goods, if it is possible. This procedure is known as rehabilitation of defective goods.

1.3 Top management communicating , hazard analysis , high-quality ,recommendations:

Top management communicating

Risk Management process:

The Risk Management Process consists of a series of steps that, when undertaken in sequence, enable continual improvement in decision-making.

Steps of the Risk Management Process:

Step 1. Communicate and consult.

Step 2. Establish the context.

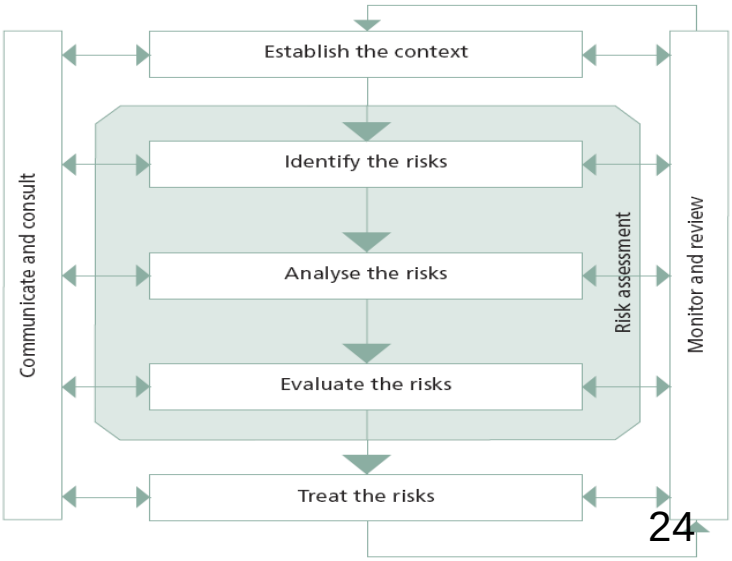
Step 3. Identify the risks.

Step 4. Analyze the risks.

Step 5. Evaluate the risks.

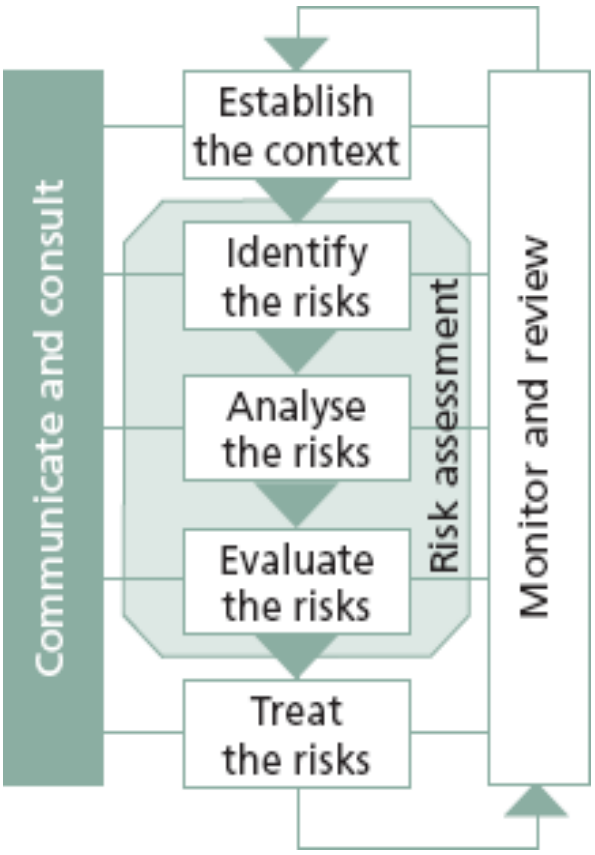
Step 6. Treat the risks.

Step 7. Monitor and review



Step 1.Communicate and consult

-Communication and consultation aims to identify who should be involved in assessment of risk (including identification, analysis and evaluation) and it should engage those who will be involved in the treatment, monitoring and review of risk.



-As such, communication and consultation will be reflected in each step of the process described here.

-As an initial step, there are two main aspects that should be identified in order to establish the requirements for the remainder of the process.

-***<u>These are communication and consultation aimed at</u>:***

A- Eliciting risk information

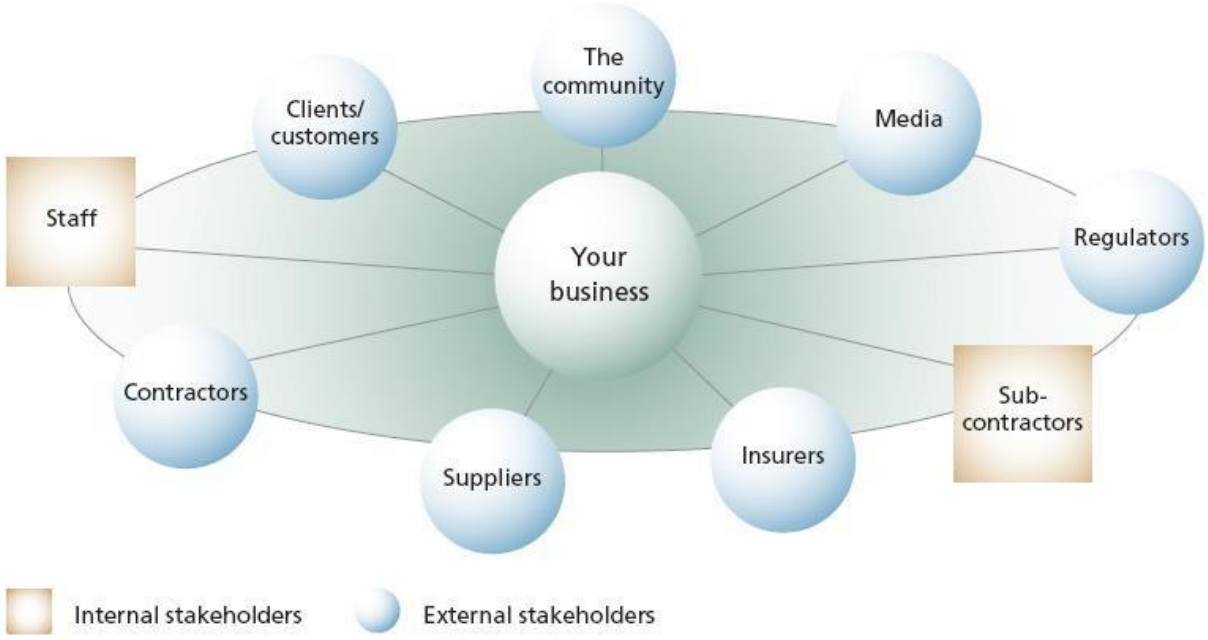
B-Managing stakeholder perceptions for management of risk.

A- Eliciting risk information

-Communication and consultation may occur within the organization or between the organization and its stakeholders.

-It is very rare that only one person will hold all the information needed to identify the risks to a business or even to an activity or project.

-It therefore important to identify the range of stakeholders who will assist in making this information complete.



Tips for effective communication and consultation

Determine at the outset whether a communication strategy and/or plan is required

• Determine the best method or media for communication and consultation

• The significance or complexity of the issue or activity in question can be used as a guide as to how much communication and consultation is required: the more complex and significant to the organization, the more detailed and comprehensive the requirement.

Step 2. Establish the context

provides a five-step process to assist with establishing the context within which risk will be identified.

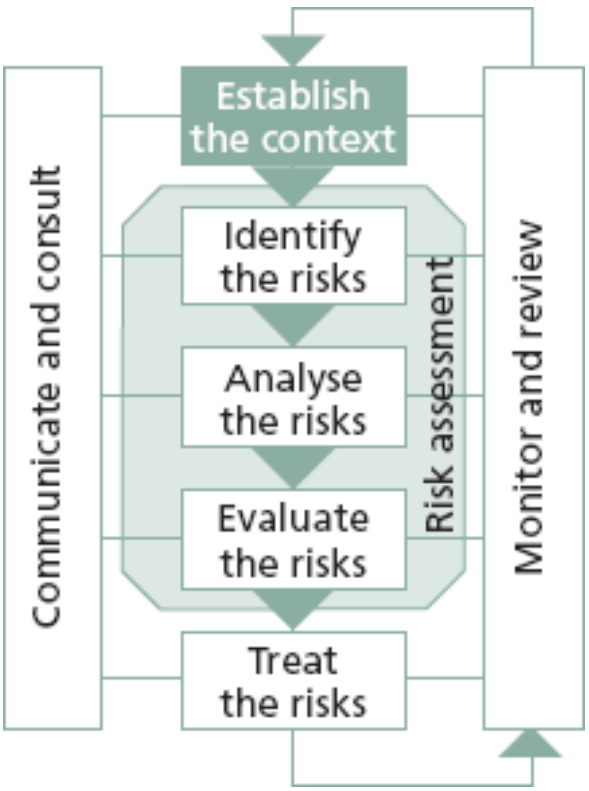
1 Establish the internal context

2 Establish the external context

3 Establish the risk management context

4 Develop risk criteria

5 Define the structure for risk analysis



1 Establish the internal context

-As previously discussed, risk is the chance of something happening that will impact on objectives.

As such, the objectives and goals of a business, project or activity must first be identified to ensure that all significant risks are understood.

This ensures that risk decisions always support the broader goals and objectives of the business. This approach encourages long-term and strategic thinking.

In establishing the internal context, the business owner may also ask themselves the following questions:

- Is there an internal culture that needs to be considered? For example, are staff Resistant to change? Is there a professional culture that might create unnecessary risks for the business?

- What staff groups are present?

- What capabilities does the business have in terms of people, systems, processes, equipment and other resources?

2. Establish the external context

- This step defines the overall environment in which a business operates and includes an understanding of the clients' or customers' perceptions of the business. An analysis of these factors will identify the strengths, weaknesses, opportunities and threats to the business in the external environment.
- A business owner may ask the following questions when determining the external context:
- • What regulations and legislation must the business comply with?
- • Are there any other requirements the business needs to comply with?
- • What is the market within which the business operates? Who are the competitors?
- • Are there any social, cultural or political issues that need to be considered?

Tips for establishing internal and external contexts

-Determine the significance of the activity in achieving the organization's goals and objectives

- Define the operating environment

- Identify internal and external stakeholders and determine their involvement in the risk management process.

3- Establish the risk management context

- Before beginning a risk identification exercise, it is important to define the limits, objectives and scope of the activity or issue under examination.

- For example, in conducting a risk analysis for a new project, such as the introduction of a new piece of equipment or a new product line, it is important to clearly identify the parameters for this activity to ensure that all significant risks are identified.

- ***Tips for establishing the risk management context***

  • Define the objectives of the activity, task or function

  • Identify any legislation, regulations, policies, standards and operating procedures that need to be complied with

  • Decide on the depth of analysis required and allocate resources accordingly

  • Decide what the output of the process will be, e.g. a risk assessment, job safety analysis or a board presentation. The output will determine the most appropriate structure and type of documentation.

4. Develop risk criteria

Risk criteria allow a business to clearly define unacceptable levels of risk. Conversely, risk criteria may include the acceptable level of risk for a specific activity or event. In this step the risk criteria may be broadly defined and then further refined later in the risk management process.

Tips for developing risk criteria

- Decide or define the acceptable level of risk for each activity
- Determine what is unacceptable
- Clearly identify who is responsible for accepting risk and at what level.

5. Define the structure for risk analysis

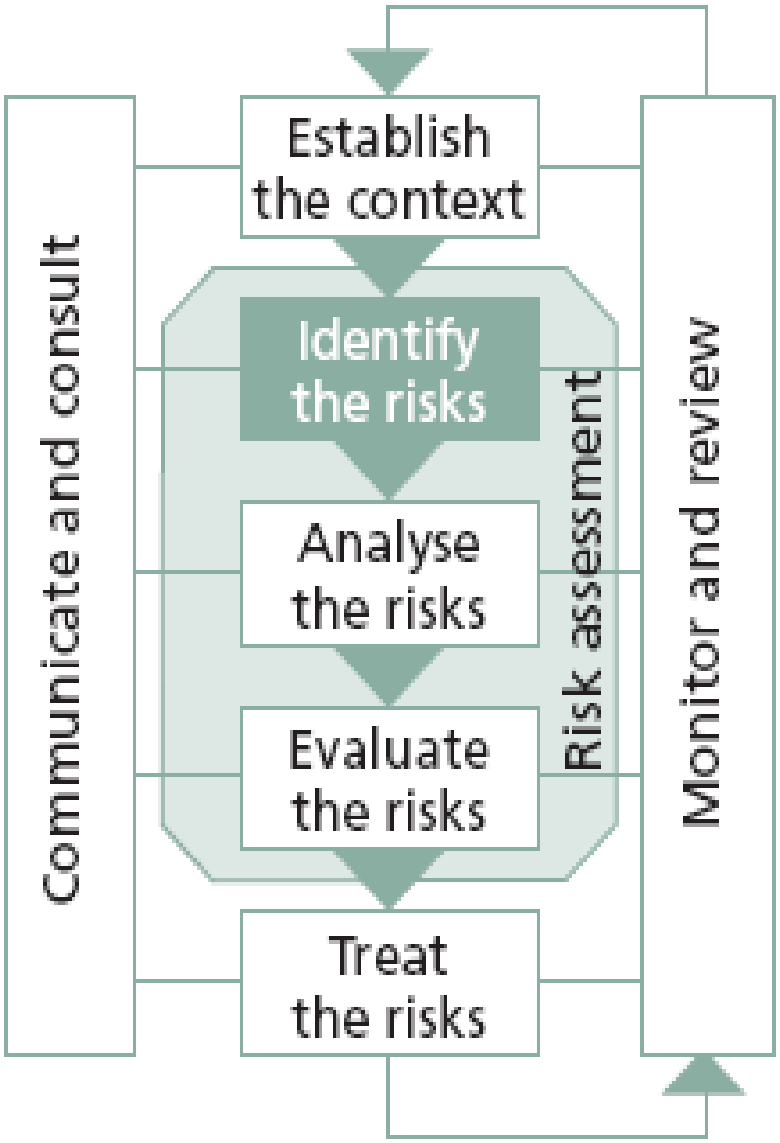
Isolate the categories of risk that you want to manage. This will provide greater depth and accuracy in identifying significant risks.

The chosen structure for risk analysis will depend upon the type of activity or issue,

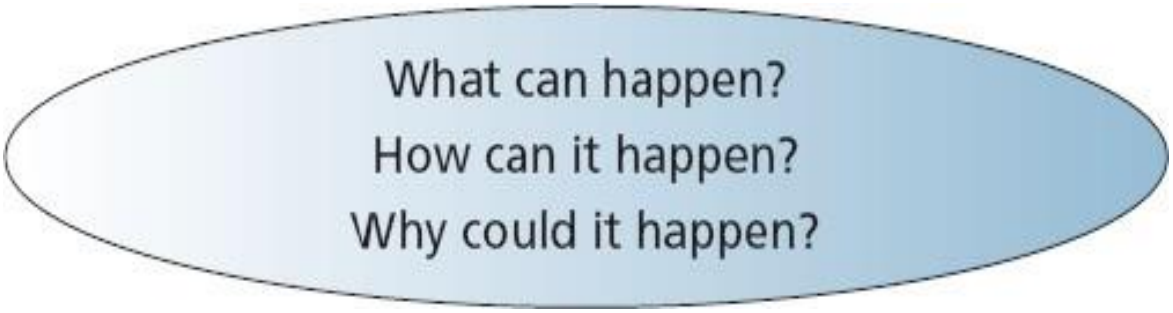
its complexity and the context of the risks.

Step 3. Identify the risks

- Risk cannot be managed unless it is first identified. Once the context of the business has been defined, the next step is to utilize the information to identify as many risks as possible.



- The aim of risk identification is to identify possible risks that may affect, either negatively or positively, the objectives of the business and the activity under analysis. Answering the following questions identifies the risk:



- ***<u>There are two main ways to identify risk:</u>***

  1- ***Identifying retrospective risks***

  Retrospective risks are those that have previously occurred, such as incidents or accidents. Retrospective risk identification is often the most common way to identify risk, and the easiest. It's easier to believe something if it has happened before. It is also easier to quantify its impact and to see the damage it has caused.

- There are many sources of information about retrospective risk. These include:
  - Hazard or incident logs or registers
  - Audit reports
  - Customer complaints
  - Accreditation documents and reports
  - Past staff or client surveys
  - Newspapers or professional media, such as journals or websites.

2-Identifying prospective risks

- Prospective risks are often harder to identify. These are things that have not yet happened, but might happen some time in the future.
- Identification should include all risks, whether or not they are currently being managed. The rationale here is to record all significant risks and monitor or review the effectiveness of their control.

- ***Methods for identifying prospective risks include:***
  - Brainstorming with staff or external stakeholders
  - Researching the economic, political, legislative and operating environment
  - Conducting interviews with relevant people and/or organizations
  - Undertaking surveys of staff or clients to identify anticipated issues or problems
  - Flow charting a process
  - Reviewing system design or preparing system analysis techniques.

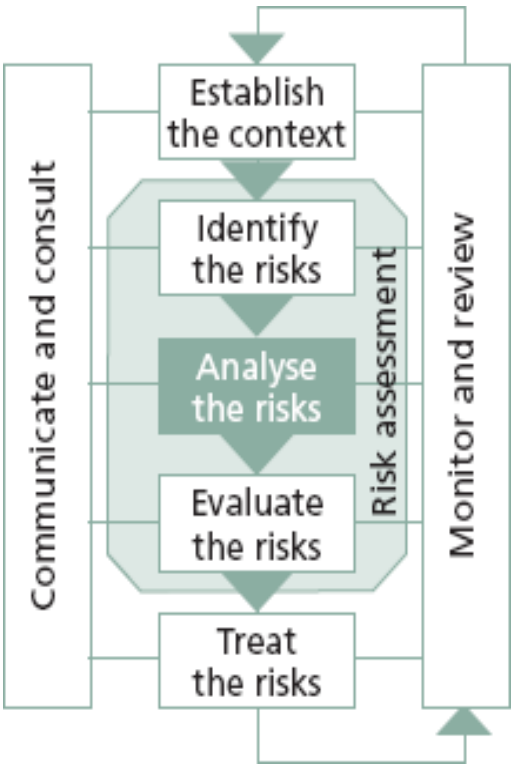
Tips for effective risk identification

Select a risk identification methodology appropriate to the type of risk and the nature of the activity Involve the right people in risk identification activities

Take a life cycle approach to risk identification and determine how risks change and evolve throughout this cycle.

Step 4. Analyze the risks

- During the risk identification step, a business owner may have identified many risks and it is often not possible to try to address all those identified.
- The risk analysis step will assist in determining which risks have a greater consequence or impact than others.



- ***What is risk analysis?***
- Risk analysis involves combining the possible consequences, or impact, of an event,
- with the likelihood of that event occurring. The result is a 'level of risk'. That is:

Risk = consequence x likelihood

- ***Elements of risk analysis***

The elements of risk analysis are as follows:

1. Identify existing strategies and controls that act to minimize negative risk and enhance opportunities.
2. Determine the consequences of a negative impact or an opportunity (these may be positive or negative).
3. Determine the likelihood of a negative consequence or an opportunity.
4. Estimate the level of risk by combining consequence and likelihood.
5. Consider and identify any uncertainties in the estimates.

Types of analysis

Three categories or types of analysis can be used to determine level of risk:

- Qualitative
- Semi-quantitative
- Quantitative.

- The most common type of risk analysis is the qualitative method.

The type of analysis chosen will be based upon the area of risk being analyzed.

- ***Tips for effective risk analysis***

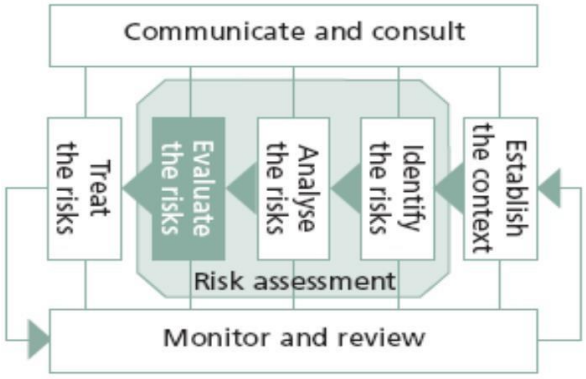
- Risk analysis is usually done in the context of existing controls – take the time to identify them
- The risk analysis methodology selected should, where possible, be comparable to the significance and complexity of the risk being analyzed, i.e. the higher the potential consequence the more rigorous the methodology
- Risk analysis tools are designed to help rank or priorities risks. To do this they must be designed for the specific context and the risk dimension under analysis.

Step 5. Evaluate the risks

Risk evaluation involves comparing the level of risk found during the analysis process with previously established risk criteria, and deciding whether these risks require treatment.

The result of a risk evaluation is a prioritized list of risks that require further action.

This step is about deciding whether risks are acceptable or need treatment.



- ***Risk acceptance***

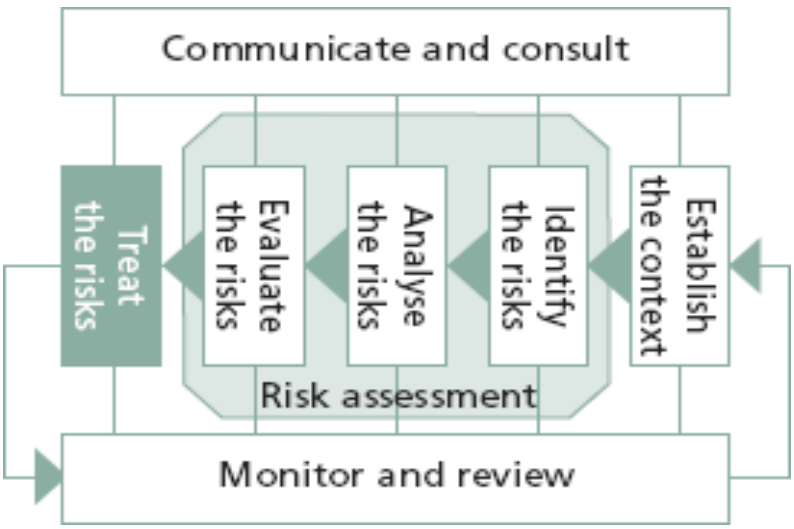
A risk may be accepted for the following reasons:

- The cost of treatment far exceeds the benefit, so that acceptance is the only option (applies particularly to lower ranked risks)
- The level of the risk is so low that specific treatment is not appropriate with available resources
- The opportunities presented outweigh the threats to such a degree that the risks justified
- The risk is such that there is no treatment available, for example the risk that the business may suffer storm damage.

Step 6. Treat the risks

Risk treatment is about considering options for treating risks that were not considered acceptable or tolerable at Step 5.

Risk treatment involves identifying options for treating or controlling risk, in order to either reduce or eliminate negative consequences, or to reduce the likelihood of an adverse occurrence. Risk treatment should also aim to enhance positive outcomes.



- ***Options for risk treatment:***

identifies the following options that may assist in the minimization of negative risk or an increase in the impact of positive risk.

1 Avoid the risk

2 Change the likelihood of the occurrence

3 Change the consequences

4 Share the risk

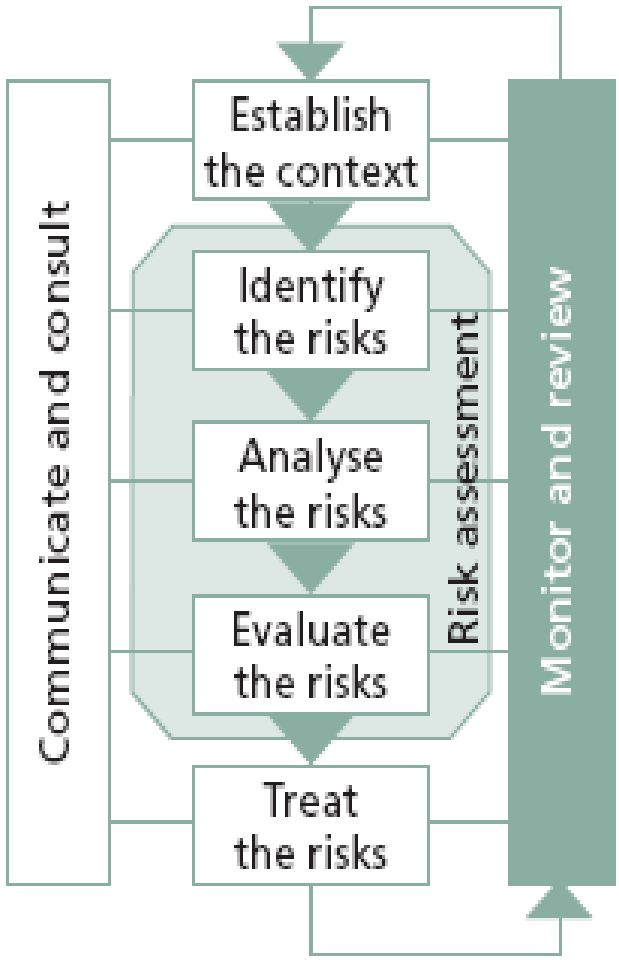
5 Retain the risk

Tips for implementing risk treatments

- The key to managing risk is in implementing effective treatment options
- When implementing the risk treatment plan, ensure that adequate resources are available, and define a timeframe, responsibilities and a method for monitoring progress against the plan
- Physically check that the treatment implemented reduces the residual risk level
- In order of priority, undertake remedial measures to reduce the risk.

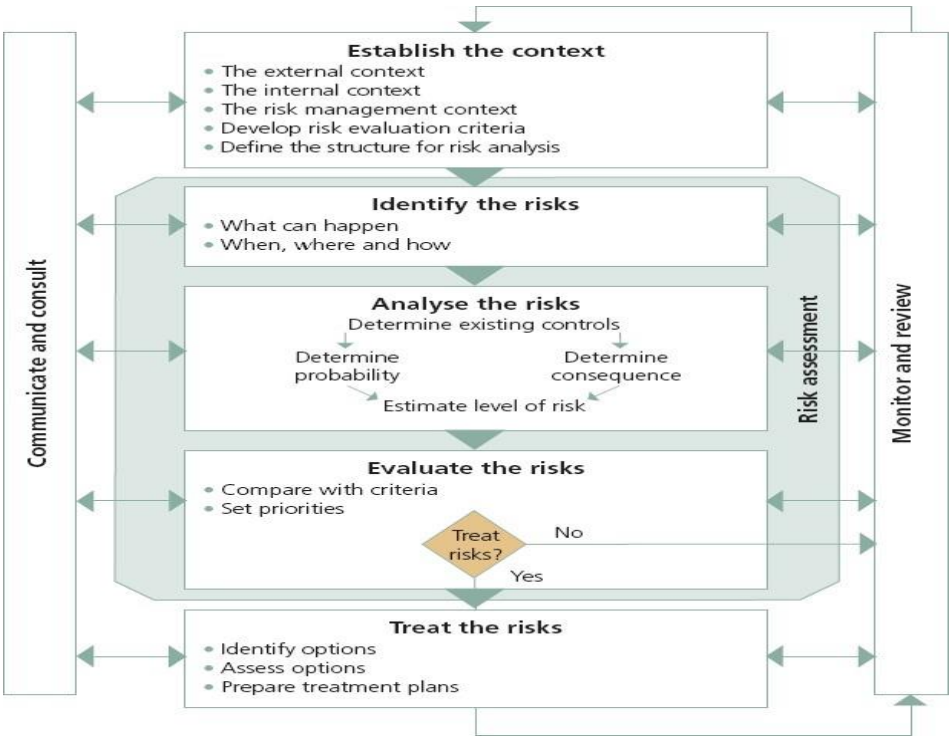
Step 7. Monitor and review

- Monitor and review is an essential and integral step in the risk management process.
- A business owner must monitor risks and review the effectiveness of the treatment plan, strategies and management system that have been set up to effectively manage risk.



- Risks need to be monitored periodically to ensure changing circumstances do not alter the risk priorities. Very few risks will remain static, therefore the risk management process needs to be regularly repeated, so that new risks are captured in the process and effectively managed.
- A risk management plan at a business level should be reviewed at least on an annual basis. An effective way to ensure that this occurs is to combine risk planning or risk review with annual business planning.

Summary of risk management steps



CHAPTER .2.

Commitment monitoring , follow up systems , the base of the hazard analysis critical point (HACCP)

2.1 Commitment Monitoring & Evaluation

- **'Monitoring'** means regularly measuring outcomes such as customer satisfaction, participation rates, contamination rates and diversion rates.
- **'Evaluating'** means drawing conclusions from the monitoring data in terms of how well the scheme is performing, or the effect of the communication activity.

Why monitor & evaluate:

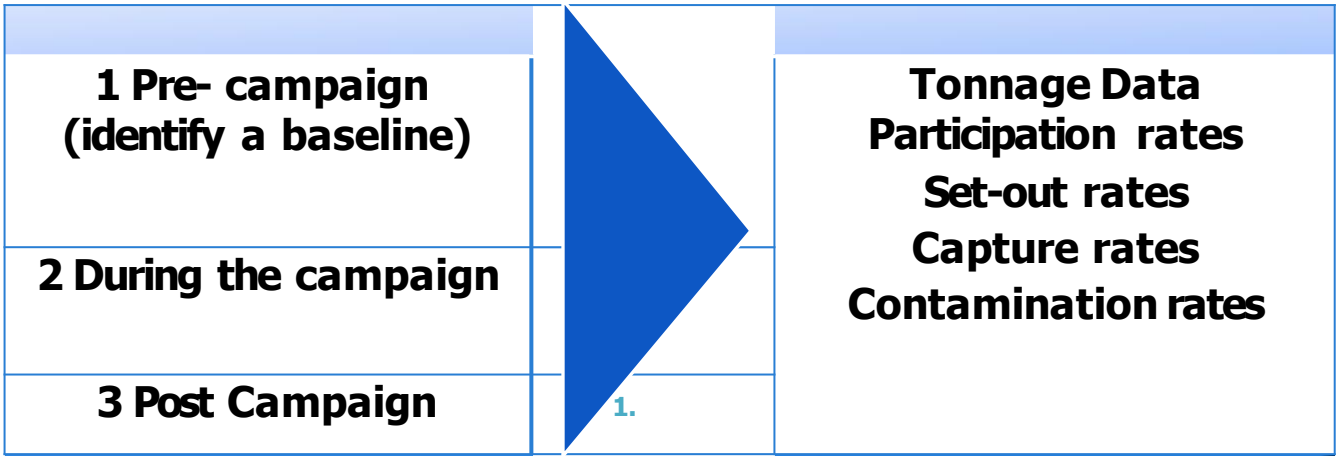
Measure customer satisfaction and user attitudes to establish how these are impacting on the performance of your scheme

- Measure progress against objectives and targets, so you will know in advance if you are likely to hit or miss them
- Identify successful systems as well as problems or performance issues, so that you can target your efforts to those neighbourhoods where improvements will make the most impact
- Assess expenditure and control costs, in terms of anticipated quantity of organics collected, demand for liners, and the impact on education and processing costs of different contamination levels
- Evaluate return on investment to justify existing budgets or persuade budget holders that more money is required to achieve statutory and local targets
- Plan scheme expansions and design (or redesign) scheme so that targets are met or exceeded
- Plan targeted communications to improve performance
- Address the issues that are really impacting on scheme success.

Monitoring methods

1 Tonnage data analysis, for example increased tonnage of organics and decreased residual waste tonnage	Request data from facility operator
2 Waste auditing, per bin, or aggregated via a visual waste audit, or physical waste characterisation	Contract specialist company to undertake composition analysis
3 Set out and participation rate monitoring, for example identifying 80% of all organics bins are put out for collection but only 50% of them contain food organics	Identify area, conduct visual inspection on (3 consecutive) collections, record households who have placed bin(s) out for collection.
4 Organics capture analysis	As method 2, conduct a tailored waste audit
5 Stakeholder feedback	Conduct focus groups and / or surveys (door to door, roadshows, events, public places)
6 Communication evaluation	Compare baseline data and results of above methods in areas you targeted with your communications campaign

When to Monitor



2.2 Sampling and inspection

- Sampling is required to identify a sub-set of the population from which to monitor to obtain data. The steps in sampling are as follows:
  - Define (profile) the population of interest – decide which factors are important. Use socio-demographics.
  - Decide how to obtain a sample that is reflective of this profile.
  - Decide how precise the results should be – the required sample size will depend on this. For participation monitoring and questionnaire surveys, 3% precision (with a 95% confidence interval) is sufficient which means a sample size of 1,100.

    Sample sizes smaller than 1,100 are viable but the results become less precise as the sample size gets smaller.
  - Design the monitoring in a way which reduces bias.
  - Conduct the monitoring and collect the data.

Scheme Evaluation

- Evaluate and interpret monitoring data by:
  - Looking at changes over time: establish a baseline and compare new data to identify trends
  - Looking at differences between areas: compare results over different geographical areas and / or demographics
  - Looking at different types of data together: use all data available to you to identify and / or understand issues
  - Identify areas for improvement: including lessons learnt for further scheme roll-out or to share with colleagues

The base of the hazard analysis critical point (HACCP) :

HACCP is:

- A systematic approach to the identification, evaluation, and control of food safety hazards.
- system is based on assessing the natural hazards or risks in a particular product or process and designing a system to control them.

The general principles of HACCP :

1. Hazard Analysis
2. Identify Critical Control Points .
3. Establish Critical Limits
4. Monitor the CCP's
5. Establish Corrective Action
6. Record keeping
7. Verification

Hazard Analysis

- Hazards :biological, chemical, and physical which are conditions cause a health risk to the consumer.
- In order to conduct the hazard analysis a flow diagram of the complete process is important.

Identify critical control points

- CCP’S are the points in a food's production (from its raw state To consumption) at which the potential hazard can be controlled or eliminated.

Establish Critical Limits

- Establish preventive measures with critical limits for each control point.

Monitor the CCP's

- Monitoring : is a planned sequence of measurements or observations to ensure the product or process is in control.

Establish Corrective Action

- Establish corrective actions (for the product or process) when monitoring shows that a critical limit has loss of control .

Record keeping

- The HACCP system requires the preparation and maintenance of a written HACCP plan together with other documentation. This must include all records generated during the monitoring of each CCP and notations of corrective actions taken.

Verification

- Verification :is the activities that determine the validity of the HACCP plan and that the system is operating according to the plan .
- Verification activities are carried out by individuals within a company, experts team, and regulatory agencies

The HACCP Plan

The HACCP Plan is the written document which is based upon the principles of HACCP and which delineates the procedures to be followed.

Developing a HACCP Plan

The format of HACCP plans will vary depending on the product and process.

In the development of a HACCP plan, five preliminary tasks need to be accomplished before the application of the HACCP principles to a specific product and process.

Assemble the HACCP Team

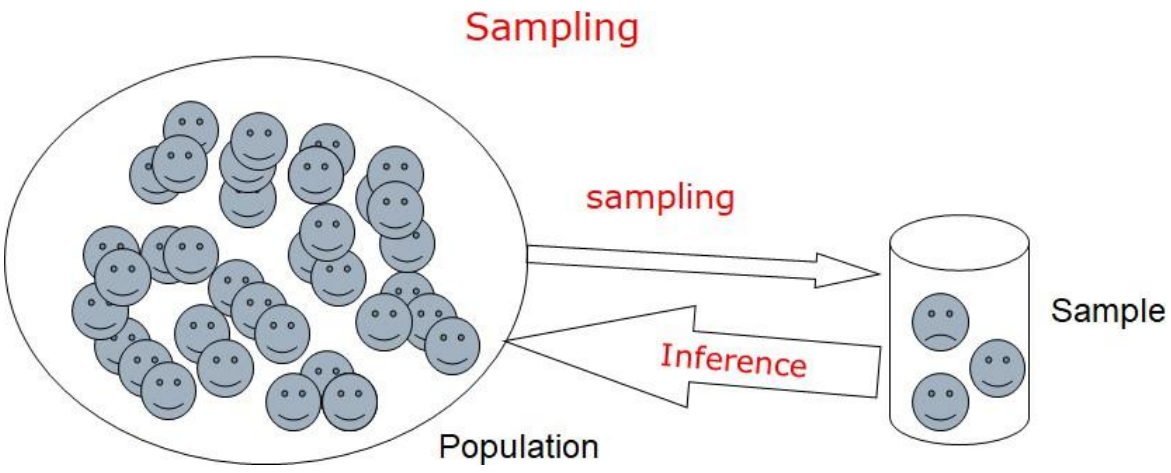
Describe the Food and its Distribution

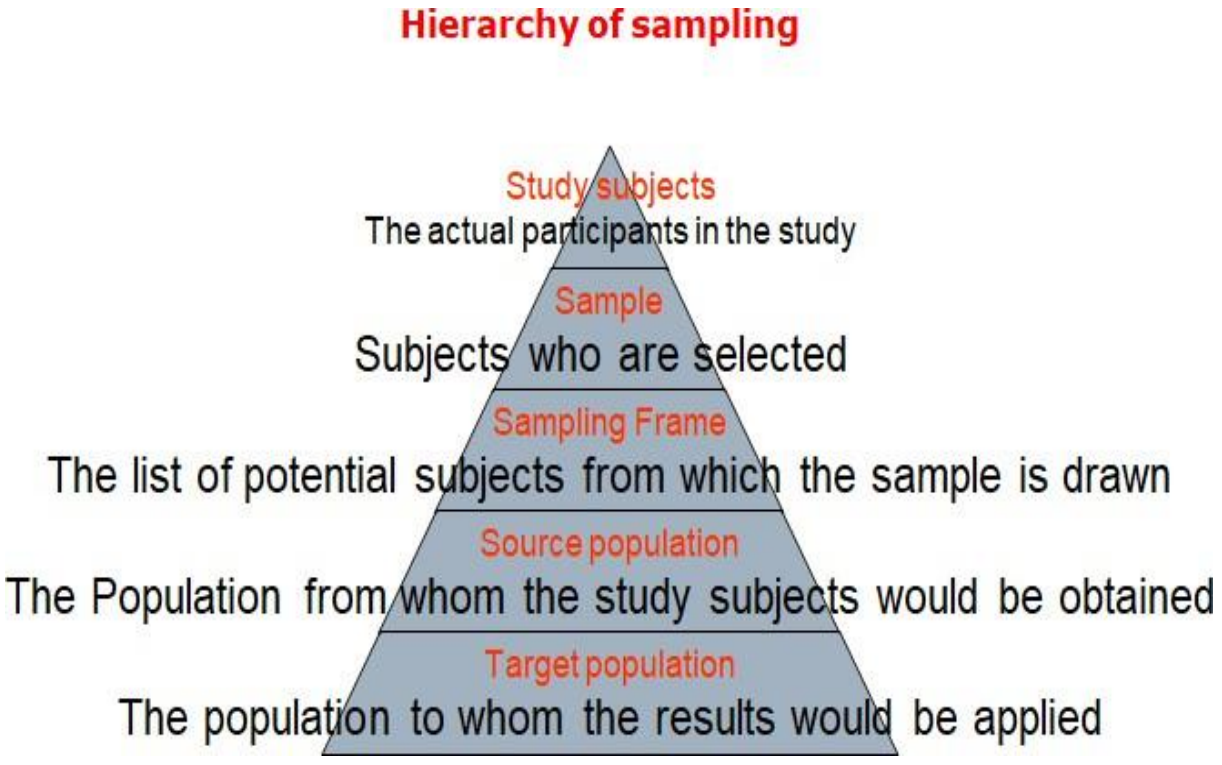
Describe the Intended Use and Consumers of the Food

Develop a Flow Diagram Which Describes the Process

Verify the Flow Diagram

Sampling and inspections , sample size , sampling error , sampling design and inspection:





Characteristics of Good Samples

- ✓ 3 factors that influence sample representativeness
  - ☐ Sampling procedure
  - ☐ Sample size
  - ☐ Participation (response)
- ✓ When might you sample the entire population?
  - ☐ When your population is very small
  - ☐ When you have extensive resources
  - ☐ When you don't expect a very high response
- ○ **Accessible**
- ○ **Low cost**

Definitions:

- **population (also called source population or target population):** is a group of individuals persons, objects, or items from which samples are taken for measurement.
  - It refers to the entire group of individuals or objects to which researchers are interested in generalizing the conclusions.
- **Census:** Obtained by collecting information about each member of a population. Studying the whole population and requires a great deals of time, money and energy.
- Sample survey: study sample and draw conclusions about populations. It is cheaper in terms of cost, practical & convenient in terms of technicalities, saves time & energy.
- **Sampling Frame:** is the list of people from which the sample is taken. It is the list from which the potential respondents are drawn.
  - It should be comprehensive, complete and up-to-date.
  - Examples of sampling frame: Electoral Register; Postcode Address File; telephone book and so on.
- **Probability samples**: With probability sampling methods, each population element has a known (non-zero) chance of being chosen for the sample.

- **Non-probability samples**: With non-probability sampling methods, we do not know the probability that each population element will be chosen, and/or we cannot be sure that each population element has a non-zero chance of being chosen

- **Sampling unit** - the unit of selection in the sampling process
- **Study unit (study subjects)**- the unit on which information is collected or on which observations are made. E.g. Familiar examples are families, towns, litters, branches of a company, individual subjects or schools.

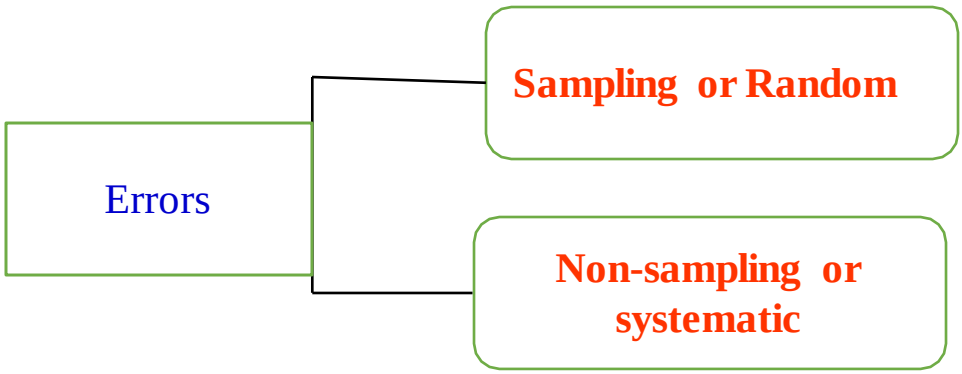
- The sampling unit is not necessarily the same as the study unit.
  - If the objective is to determine the availability of latrine,
  - then the study unit would be the household;
  - If the objective is to determine the prevalence of trachoma, then the study unit would be the individual.

- **Sampling fraction (Sampling interval)** - the ratio of the number of units in the sample to the number of units in the reference population (N/n)

1. Sampling error:

A sample is expected to mirror the population from which it comes, however, there is no guarantee that any sample will be precisely representative of the population.

- No sample is the exact mirror image of the population .



-Random error- the sample selected is not representative of the population due to chance

- The uncertainty associated with an estimate that is based on data gathered from a sample of the population rather than the full population is known as sampling error.
- Sampling errors are the random variations in the sample estimates around the true population parameters.

- **the level of it is controlled by sample size**
- **a larger sample size leads to a smaller sampling error.** it decreases with the increase in the size of the sample, and it happens to be of a smaller magnitude in case of homogeneous population.

When n = N ⇒ sampling error = 0

✓ Can not be avoided or totally eliminated

- why do **sample estimates have uncertainty** associated with them? There are two reasons.
  - Estimates of characteristics from the sample data can differ from those that would be obtained if the entire population were surveyed.
  - Estimates from one subset or sample of the population can differ from those based on a different sample from the same population (sample to sample variations).

The cause of sampling error

- Chance: main cause of sampling error and is the error that occurs just because of bad luck.
- Sampling bias: Sampling bias is a tendency to favor the selection of participants that have particular characteristics.
- The chance component (sometimes called random error) exists no matter how carefully the selection procedures are implemented, and the only way to minimize chance-sampling errors is to select a sufficiently large sample.

- 2. Non Sampling Error
- It is a type of systematic error in the design or conduct of a sampling procedure which results in distortion of the sample, so that it is no longer representative of the reference population.
- We can eliminate or reduce the non-sampling error (bias) by careful design of the sampling procedure and not by increasing the sample size.
- It can occur whether the total study population or a sample is being used.

- The basic types of non-sampling error
  - Non-response error
  - Response or data error

- A *non-response error* occurs when units selected as part of the sampling procedure do not respond in whole or in part
  - If non-respondents are not different from those that did respond, there is no non-response error
  - When non-respondents constitute a significant proportion of the sample (about 15% or more
- A *response or data error* is any systematic bias that occurs during data collection, analysis or interpretation
  - Respondent error (e.g., lying, forgetting, etc.)
  - Interviewer bias
  - Recording errors
  - Poorly designed questionnaires

- Systematic error makes survey results unrepresentative of the target population by distorting the survey estimates in one direction.
- Random error can distort the results in any given direction but tend to balance out on average
- Thus, the total survey error

sampling error + non-sampling error

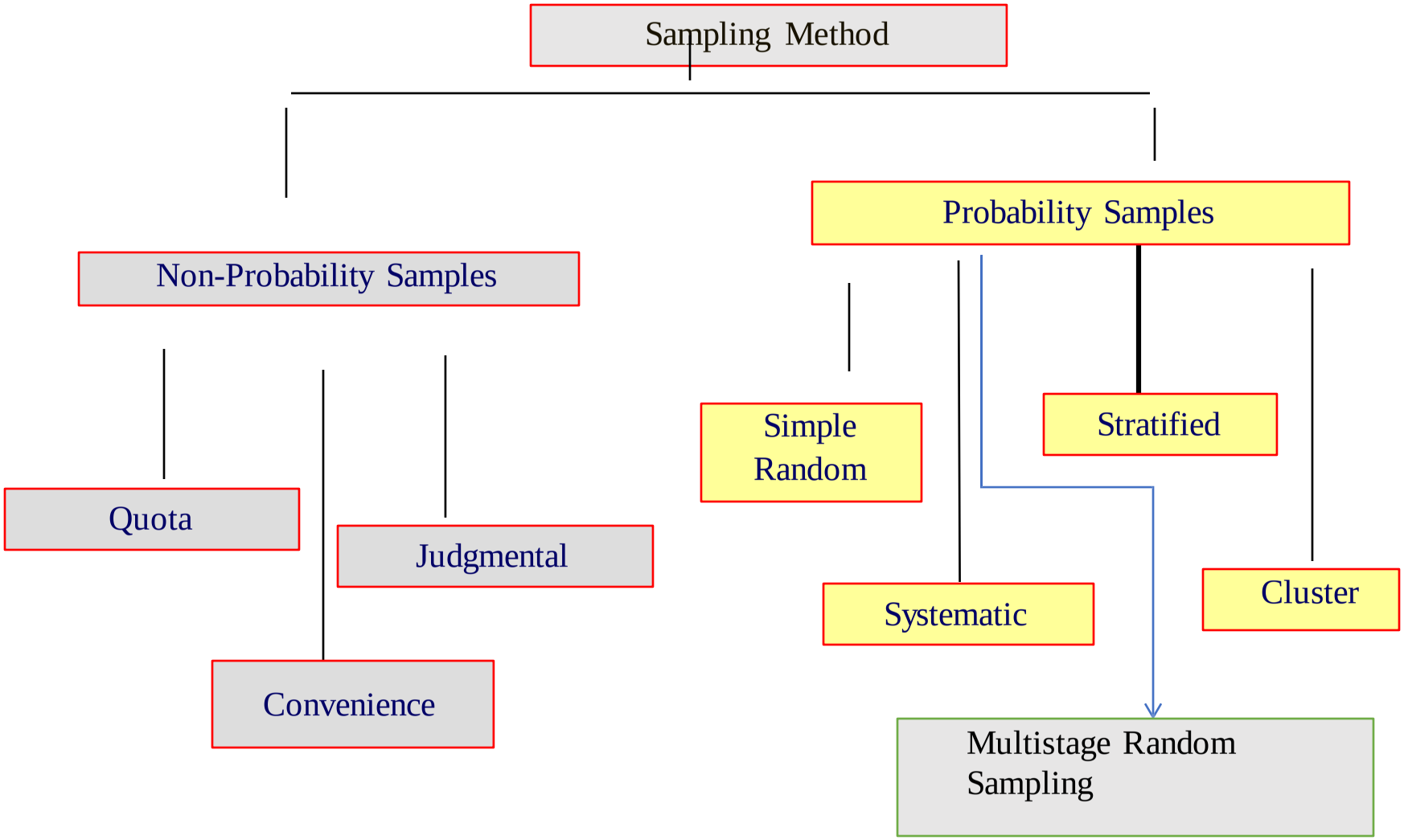
Advantage of sampling

- We obtain a sample rather than a complete enumeration (a census) of the population for many reasons.
  - Feasibility it may be the only feasible method of collecting data
  - Reduced cost sampling reduces demands on resource such as finance, personal and material
  - Greater accuracy sampling may lead to better accuracy of collecting data.
  - Greater speed data can be collected and summarized more quickly

Disadvantage of Sampling

- If sampling is biased, or not representative or too small the conclusion may not be valid and reliable
- If the population is very large and there are many sections and subsections, the sampling procedure becomes very complicated
- If the researcher does not possess the necessary skill and technical knowledge in sampling procedure, then the outcome will be devastated.

Types of Sampling Methods



Probability Sampling Method:

The random ("equal chance“) and "independent" components of random sampling are what makes us confident that the sample has a reasonable chance of representing the population

- What does it mean to be independent? The researchers select each person for the study separately.
- Let us say you were asked to participate in an experiment, enjoyed it, and told your friends to contact the researcher to volunteer for the study.
  - This would be an example of non-independent sampling.

Non-Probability Sampling Method

- In the presence of constraints to use probability sampling strategies, the alternative sampling method is non-probability sampling method.
- Non-probability sampling strategies are used when it is practically impossible to use probability sampling strategies.
- Non-probability sampling is sampling procedure which does not afford any basis for estimating the probability that each item in the population has of being included in the sample.

Sample Size Determination DeterminingL

the sample size for a study is a crucial component of study to include sufficient numbers of subjects so that statistically significant results can be detected.

- "How large a sample do I need?“
- The answer will depend on the aims, nature and scope of the study and on the expected result. All of which should be carefully considered at the planning stage.

Factors to determine sample size

- Size of population
- Resources – subjects, financial, manpower
- Method of Sampling- random, stratified
- Degree of difference to be detected
- Variability (S.D.) – pilot study, historical
- Degree of Accuracy (or errors)

  - Type I error (alpha) $p<0.05$

  - Type II error (beta) less than 0.2 (20%)

  - Power of the test : more than 0.8 (80%)
- Statistical Formulae
- Dropout rate, non-compliance to Rx

Sample size determination depending on outcome variables.

- There are three possible categories of outcome variables.
  - The first is where the variable of interest has only two alternatives response: yes/no, dead/alive, vaccinated/not vaccinated and so on.
  - The second category covers those outcome variable with multiple, mutually exclusive alternatives responses, such as marital status, religion, blood group and so on.
  - For these two categories of outcome variables, the data are generally express as percentages or rates.
  - So we can use percentage to compute the sample size.
  - The third category covers continuous response variables such as birth weight, age at first marriage, blood pressure and cerium uric acid level, for which numerical measurement are usually made.
  - In this case the data are summarize in the form of means and standard deviations or their derivatives.
- There are several approaches to determining the sample size.
- Depending on the type of response variable, whether it is categorical or continuous, we will have two sets of formulas.
- The sample size determination formulas come from the formulas for the maximum error of the estimates and is derived by solving for n.

Sample for Single population

To estimate sample size for single survey using simple or systematic random sampling, need to know:

- Estimate of the prevalence of the outcome
- Precision desired
- Design effect
- Size of total population
- Level of confidence (always use 95%)

Sample size for single population mean

This is the condition in which the research question is about mean.

- Standard deviation (σ) of the population: It is rare that a researcher knows the exact standard deviation of the population.
- Typically, the standard deviation of the population is estimated:
  - from the results of a previous survey,
  - from a pilot study,
  - from secondary data,
  - from judgment of the researcher.

- Maximum acceptable difference (w): This is the maximum amount of error that you are willing to accept.
- Desired confidence level ($Z\alpha/2$) : is your level of certainty that the sample mean does not differ from the true population mean by more than the maximum acceptable difference. Commonly we use a 95% confidence level.
- Then the sample size determination formula for single population mean is defined by:

$$n = \frac{z_{\alpha/2}^2 * \delta^2}{w^2}$$

- Where
  - α= The level of significance which can be obtain as 1-confidence level.
  - σ=Standard deviation of the population
  - w= Maximum acceptable difference
  - $z_{\alpha/2}$ = The value under standard normal table for the given value of confidence level

Sample Size for Single Population Proportion

- This is the situation in which the variable of interest is categorical.
- Three questions must be answered to determine the sample size for single population proportion:
- Best estimate of population proportion of the variable of interest : Make your best estimate of what the actual percent of the survey characteristic is.
- The possible source of this proportion are:
  - ✓ from the results of a previous study,
  - ✓item from a pilot study,
  - ✓item judgment of the researcher.
  - ✓item Simply taking 50%

- Then the formula for the sample size of single population proportion is defined as:

$$n = \frac{z^2_{\alpha/2} * p(1-p)}{w^2}$$

- Where α = the level of significance which can be obtained as 1-confidence level.
- P = best estimate of population proportions
- W = maximum acceptable difference
- the value under standard normal table for the given value of confidence level

Sampling Design and Procedures

1) Overview

2) Sample or Census

3) The Sampling Design Process

i. Define the Target Population

ii. Determine the Sampling Frame

iii. Select a Sampling Technique

iv. Determine the Sample Size

v. Execute the Sampling Process

4) A Classification of Sampling Techniques

Nonprobability Sampling Techniques

Convenience Sampling
Judgmental Sampling
Quota Sampling
Snowball Sampling
Probability Sampling Techniques
Simple Random Sampling
Systematic Sampling
Stratified Sampling
Cluster Sampling
Other Probability Sampling Techniques
Choosing Nonprobability versus Probability Sampling

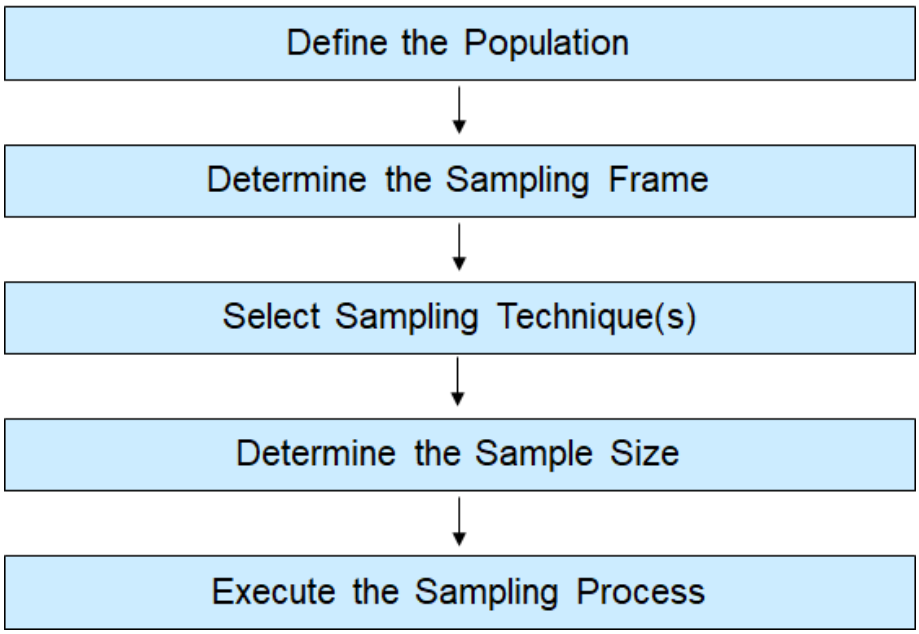
Uses of Nonprobability versus Probability Sampling

International Marketing Research
Ethics in Marketing Research
Internet and Computer Applications
Focus On Burke

Sample vs. Census

Type of Study	Conditions Favoring the Use of Sample	Census
1. Budget	Small	Large
2. Time available	Short	Long
3. Population size	Large	Small
4. Variance in the characteristic	Small	Large
5. Cost of sampling errors	Low	High
6. Cost of nonsampling errors	High	Low
7. Nature of measurement	Destructive	Nondestructive
8. Attention to individual cases	Yes	No

The Sampling Design Process



Define the Target Population

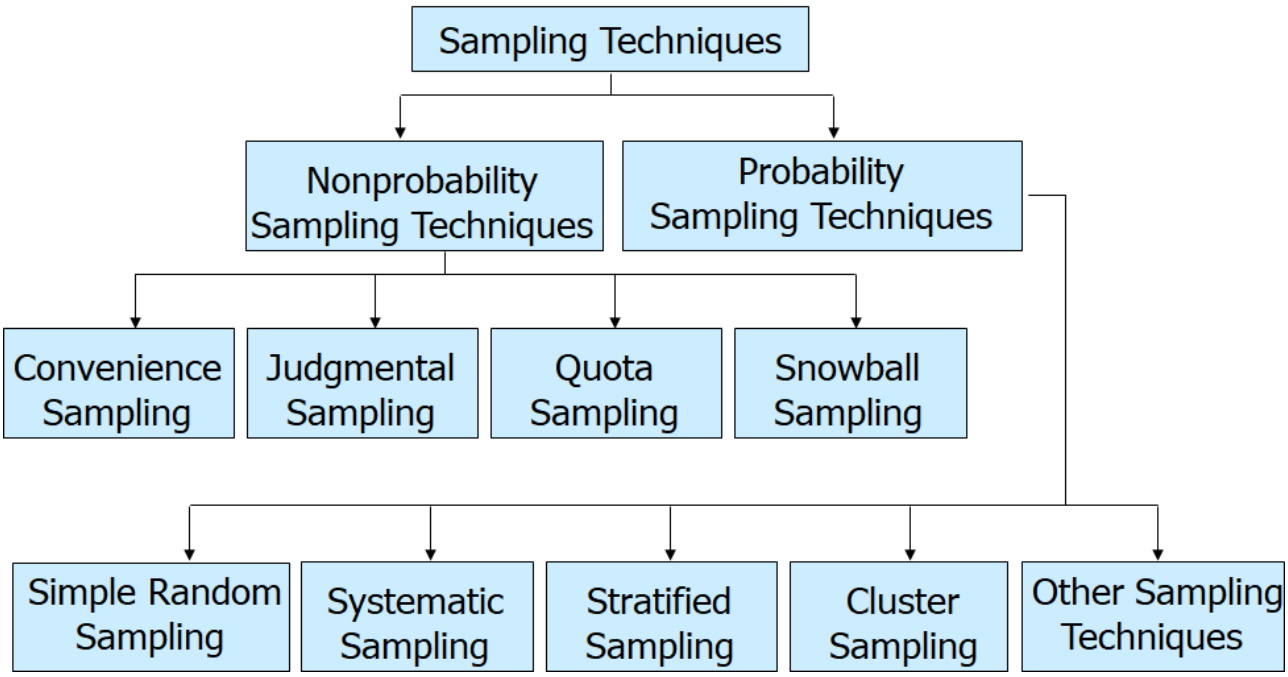
The target population is the collection of elements or objects that possess the information sought by the researcher and about which inferences are to be made. The target population should be defined in terms of elements, sampling units, extent, and time.

- An **element** is the object about which or from which the information is desired, e.g., the respondent.
- A **sampling unit** is an element, or a unit containing the element, that is available for selection at some stage of the sampling process.
- **Extent** refers to the geographical boundaries.
- **Time** is the time period under consideration.

Important qualitative factors in determining the sample size

- the importance of the decision
- the nature of the research
- the number of variables
- the nature of the analysis
- sample sizes used in similar studies
- incidence rates
- completion rates
- resource constraints

Classification of Sampling Techniques



Convenience sampling :

attempts to obtain a sample of convenient elements. Often, respondents are selected because they happen to be in the right place at the right time.

use of students, and members of social organizations mall intercept interviews without qualifying the respondents department stores using charge account lists "people on the street" interviews

Judgmental sampling:

is a form of convenience sampling in which the population elements are selected based on the judgment of the researcher.

test markets purchase engineers selected in industrial marketing research bellwether precincts selected in voting behavior research expert witnesses used in court

Quota sampling :

may be viewed as two-stage restricted judgmental sampling.

- The first stage consists of developing control categories, or quotas, of population elements.
- In the second stage, sample elements are selected based on convenience or judgment.

	Population composition		Sample composition
Control Characteristic	Percentage	Percentage	Number
Sex			
Male	48	48	480
Female	52	52	520
	100	100	1000

In snowball sampling:

an initial group of respondents is selected, usually at random.

After being interviewed, these respondents are asked to identify others who belong to the target population of interest.

Subsequent respondents are selected based on the referrals.

Simple Random Sampling

- Each element in the population has a known and equal probability of selection.
- Each possible sample of a given size (n) has a known and equal probability of being the sample actually selected.
- This implies that every element is selected independently of every other element.

Systematic Sampling

The sample is chosen by selecting a random starting point and then picking every ith element in succession from the sampling frame.

The sampling interval, i, is determined by dividing the population size N by the sample size n and rounding to the nearest integer.

When the ordering of the elements is related to the characteristic of interest, systematic sampling increases the representativeness of the sample.

If the ordering of the elements produces a cyclical pattern, systematic sampling may decrease the representativeness of the sample.

For example, there are 100,000 elements in the population and a sample of 1,000 is desired. In this case the sampling interval, i, is 100. A random number between 1 and 100 is selected. If, for example, this number is 23, the sample consists of elements 23, 123, 223,…., and so on.

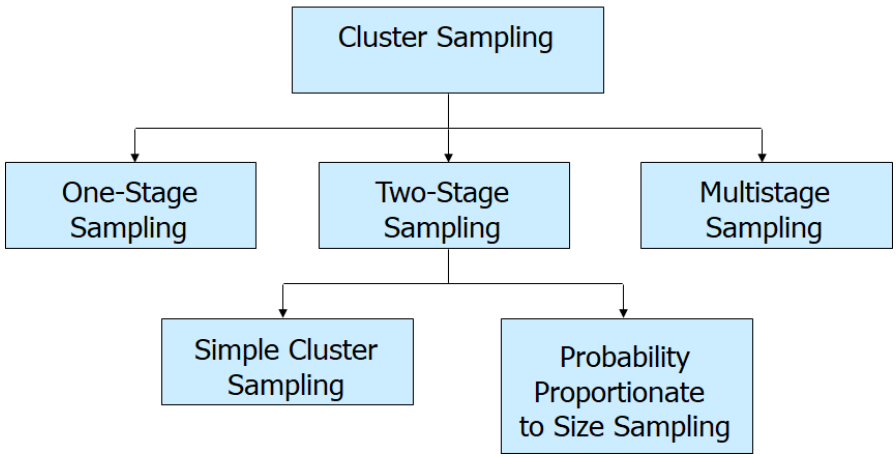
Stratified Sampling

- A two-step process in which the population is partitioned into subpopulations, or strata.
- The strata should be mutually exclusive and collectively exhaustive in that every population element should be assigned to one and only one stratum and no population elements should be omitted.
- Next, elements are selected from each stratum by a random procedure, usually SRS.
- A major objective of stratified sampling is to increase precision without increasing cost.
- The elements within a stratum should be as homogeneous as possible, but the elements in different strata should be as heterogeneous as possible.
- The stratification variables should also be closely related to the characteristic of interest.
- Finally, the variables should decrease the cost of the stratification process by being easy to measure and apply.
- In proportionate stratified sampling, the size of the sample drawn from each stratum is proportionate to the relative size of that stratum in the total population.
- In disproportionate stratified sampling, the size of the sample from each stratum is proportionate to the relative size of that stratum and to the standard deviation of the distribution of the characteristic of interest among all the elements in that stratum.

Cluster Sampling

- The target population is first divided into mutually exclusive and collectively exhaustive subpopulations, or clusters.
- Then a random sample of clusters is selected, based on a probability sampling technique such as SRS.
- For each selected cluster, either all the elements are included in the sample (one-stage) or a sample of elements is drawn probabilistically (two-stage).
- Elements within a cluster should be as heterogeneous as possible, but clusters themselves should be as homogeneous as possible. Ideally, each cluster should be a small-scale representation of the population.
- In **probability proportionate to size sampling**, the clusters are sampled with probability proportional to size. In the second stage, the probability of selecting a sampling unit in a selected cluster varies inversely with the size of the cluster.

Types of Cluster Sampling



Procedures for Drawing Probability Samples

Simple Random Sampling:

1. Select a suitable sampling frame

2. Each element is assigned a number from 1 to N (pop. size)

3. Generate n (sample size) different random numbers between 1 and N

4. The numbers generated denote the elements that should be included in the sample

Stratified Sampling

1. Select a suitable frame

2. Select the stratification variable(s) and the number of strata, H

3. Divide the entire population into H strata. Based on the classification variable, each element of the population is assigned to one of the H strata

4. In each stratum, number the elements from 1 to Nh (the pop. size of stratum h)

5. Determine the sample size of each stratum, nh, based on proportionate or disproportionate stratified sampling, where:

$$\sum_{h=1}^{H} n_h = n$$

6. In each stratum, select a simple random sample of size nh

Cluster Sampling

1. Assign a number from 1 to N to each element in the population

2. Divide the population into C clusters of which c will be included in the sample

3. Calculate the sampling interval i, i=N/c (round to nearest integer)

4. Select a random number r between 1 and i, as explained in simple random sampling

5. Identify elements with the following numbers: r,r+i,r+2i,... r+(c-1)i

6. Select the clusters that contain the identified elements

7. Select sampling units within each selected cluster based on SRS or systematic sampling

8. Remove clusters exceeding sampling interval i. Calculate new population size N*, number of clusters to be selected C*= C-1, and new sampling interval i*.

Repeat the process until each of the remaining clusters has a population less than the sampling interval. If b clusters have been selected with certainty, select the remaining c-b clusters according to steps 1 through 7. The fraction of units to be sampled with certainty is the overall sampling fraction = n/N. Thus, for clusters selected with certainty, we would select ns=(n/N)(N1+N2+...+Nb) units. The units selected from clusters selected under PPS sampling will therefore be n*=n- ns.

Acceptance sampling plans , quality control tools and techniques , tools for creating new concepts:

Acceptance sampling plans:

2.3 Acceptance Sampling

Contributions of Dodge and Romig to acceptance sampling

- Acceptance sampling is an important field of statistical quality control that was popularized by Dodge and Romig and originally applied by the U.S. military to the testing of bullets during World War II.
- If every bullet was tested in advance, no bullets would be left to ship. If, on the other hand, none were tested, malfunctions might occur in the field of battle, with potentially disastrous results.

Definition of Lot Acceptance Sampling

Dodge reasoned that a sample should be picked at random from the lot, and on the basis of information that was yielded by the sample, a decision should be made regarding the disposition of the lot. In general, the decision is either to accept or reject the lot.

This process is called Lot Acceptance Sampling or just Acceptance Sampling.

Acceptance sampling is "the middle of the road" approach between no inspection and 100% inspection.

There are two major classifications of acceptance plans: by attributes ("go, no-go") and by variables.

The attribute case is the most common for acceptance sampling, and will be assumed for the rest of this section.

A point to remember is that the main purpose of acceptance sampling is to decide whether or not the lot is likely to be acceptable, not to estimate the quality of the lot.

Acceptance sampling is employed when one or several of the following hold:

1 Testing is destructive

2 The cost of 100% inspection is very high

3-100% inspection takes too long

Acceptance Quality Control and Acceptance Sampling Lot Acceptance Sampling Plans (LASPs) :

- A lot acceptance sampling plan (LASP) is a sampling scheme and a set of rules for making decisions.
- The decision, based on counting the number of defectives in a sample, can be to accept the lot, reject the lot, or even, for multiple or sequential sampling schemes, to take another sample and then repeat the decision process.

LASPs fall into the following categories:

- Single sampling plans
- Double sampling plans
- Multiple sampling plans
- Sequential sampling plans
- Skip lot sampling plans

Single sampling plans

One sample of items is selected at random from a lot and the disposition of the lot is determined from the resulting information. These plans are usually denoted as (n,c) plans for a sample size n, where the lot is rejected if there are more than c defectives.

These are the most common (and easiest) plans to use although not the most efficient in terms of average number of samples needed.

Double sampling plans:

- After the first sample is tested, there are three possibilities:
    1. Accept the lot
    2. Reject the lot
    3. No decision
- If the outcome is (3), and a second sample is taken, the procedure is to combine the results of both samples and make a final decision based on that information.

Multiple sampling plans:

This is an extension of the double sampling plans where more than two samples are needed to reach a conclusion. The advantage of multiple sampling is smaller sample sizes.

Sequential sampling plans:

This is the ultimate extension of multiple sampling where items are selected from a lot one at a time and after inspection of each item a decision is made to accept or reject the lot or select another unit.

Skip lot sampling means that only a fraction of the submitted lots are nspected.

Definitions of basic Acceptance Sampling terms

- ***Acceptable Quality Level (AQL)***:
- The AQL is a percent defective that is the base line requirement for the quality of the producer's product. The producer would like to design a sampling plan such that there is a high probability of accepting a lot that has a defect level less than or equal to the AQL.

Lot Tolerance Percent Defective (LTPD):

The LTPD is a designated high defect level that would be unacceptable to the consumer. The consumer would like the sampling plan to have a low probability of accepting a lot with a defect level as high as the LTPD.

Type I Error (Producer's Risk):

This is the probability, for a given (n,c) sampling plan, of rejecting a lot that has a defect level equal to the AQL. The producer suffers when this occurs, because a lot with acceptable quality was rejected. The symbol is commonly used for the Type I error and typical values for range from 0.2 to 0.01.

- ***Type II Error (Consumer's Risk):***
- This is the probability, for a given (n,c) sampling plan, of accepting a lot with a defect level equal to the LTPD. The consumer suffers when this occurs, because a lot with unacceptable quality was accepted. The symbol is commonly used for the Type II error and typical values range from 0.2 to 0.01.

Operating Characteristic (OC) Curve:

This curve plots the probability of accepting the lot (Y-axis) versus the lot fraction or percent defectives (X-axis).

The OC curve is the primary tool for displaying and investigating the properties of a LASP

Choosing a Sampling Plan:
MIL Standard 105D

Standard military sampling procedures for inspection by attributes were developed during World War II.

Army Ordnance tables and procedures were generated in the early 1940's and these grew into the Army Service Forces tables.

At the end of the war, the Navy also worked on a set of tables. In the meanwhile, the Statistical Research Group at Columbia University performed research and outputted many outstanding results on attribute sampling plans.

Description of Mil. Std. 105D

This document is essentially a set of individual plans, organized in a system of sampling schemes.

A sampling scheme consists of a combination of a normal sampling plan, a tightened sampling plan, and a reduced sampling plan plus rules for switching from one to the other.

Quality control tools and techniques

New Seven Q.C. Tools

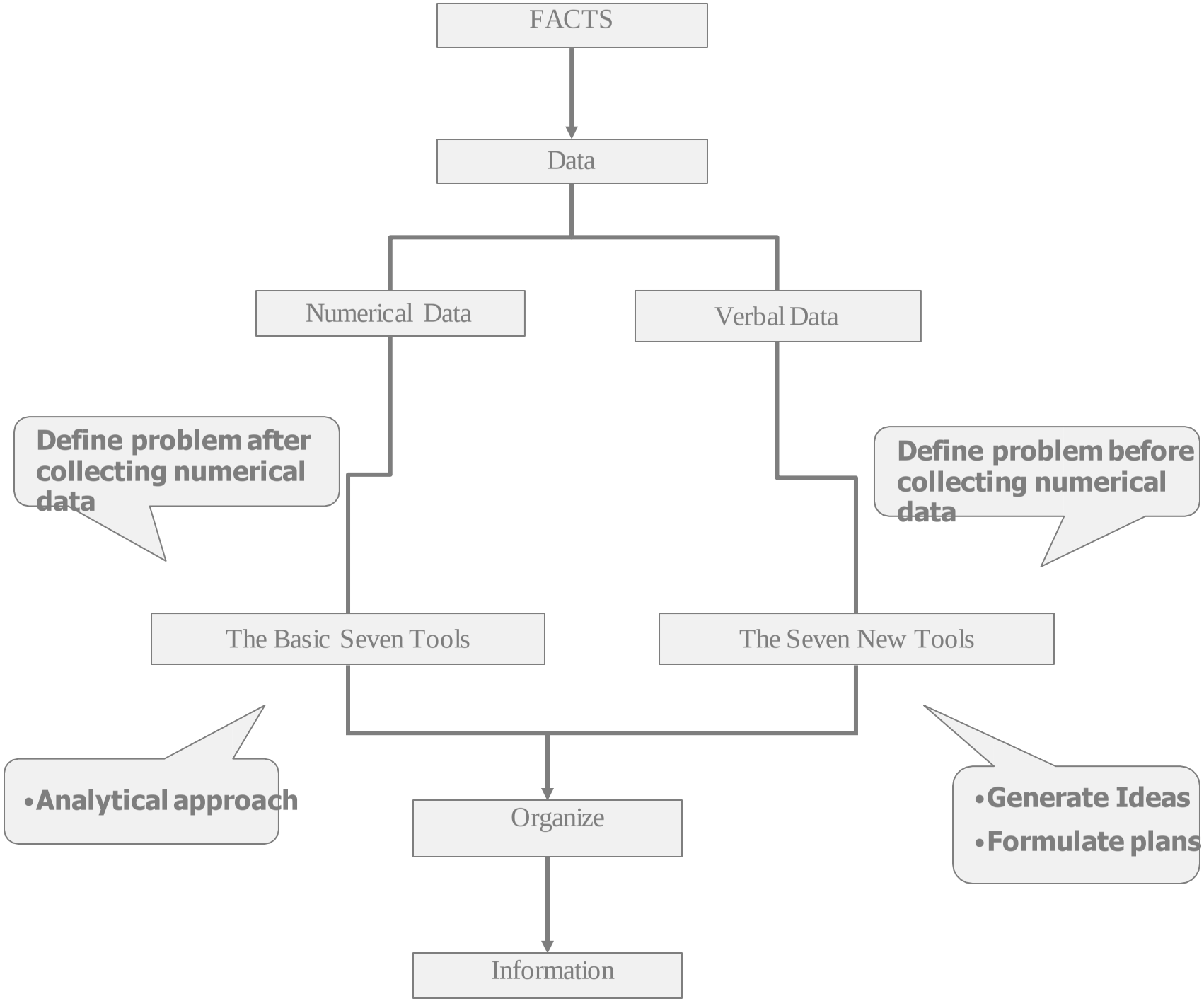
- Affinity Diagrams
- Relations Diagrams
- Tree Diagrams
- Matrix Diagrams
- Arrow Diagrams
- Process Decision Program Charts
- Matrix Data Analysis

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

Basic Seven Q.C. Tools:

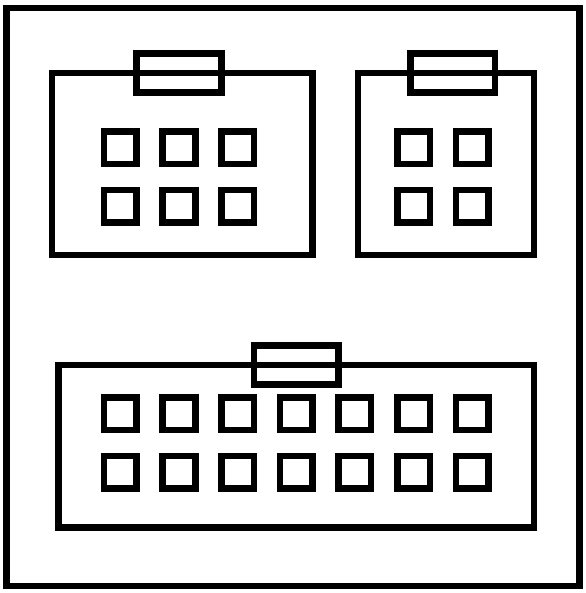
- Flow Charts
- Run Charts
- Histograms
- Pareto Diagrams
- Cause and Effect Diagrams
- Scatter Diagrams
- Control Charts

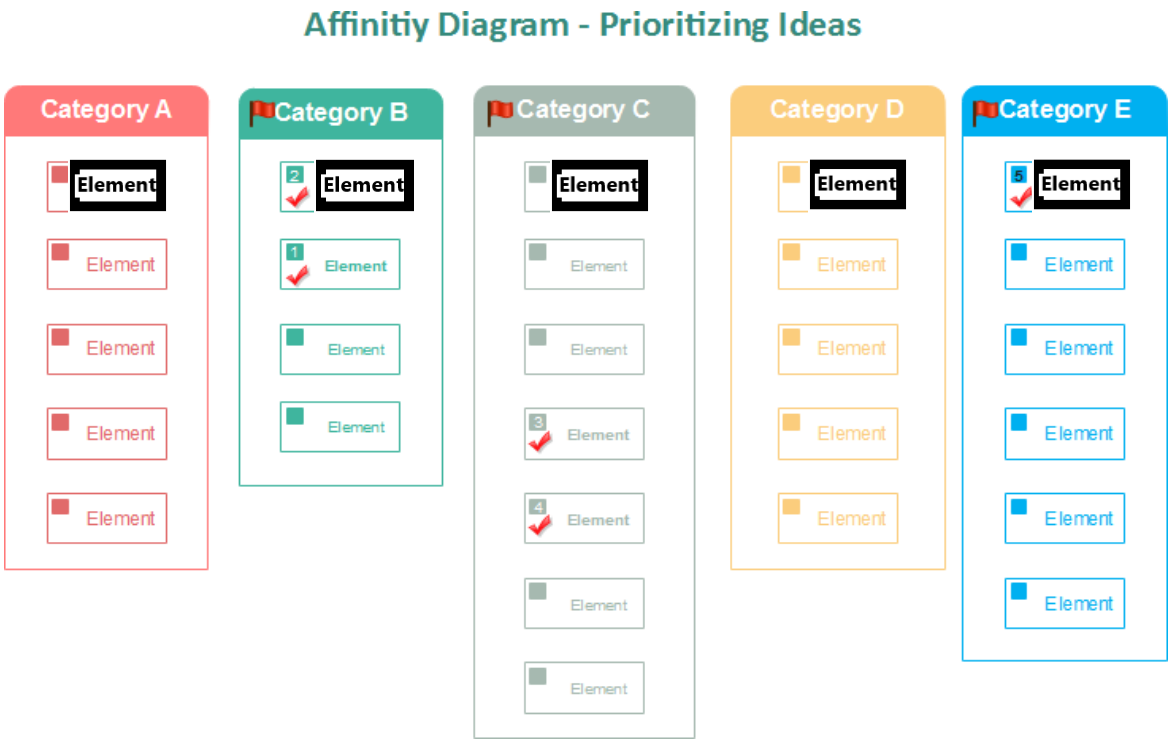
Relation Between New Seven Q.C. Tools and Basic Seven Tools



Affinity Diagram

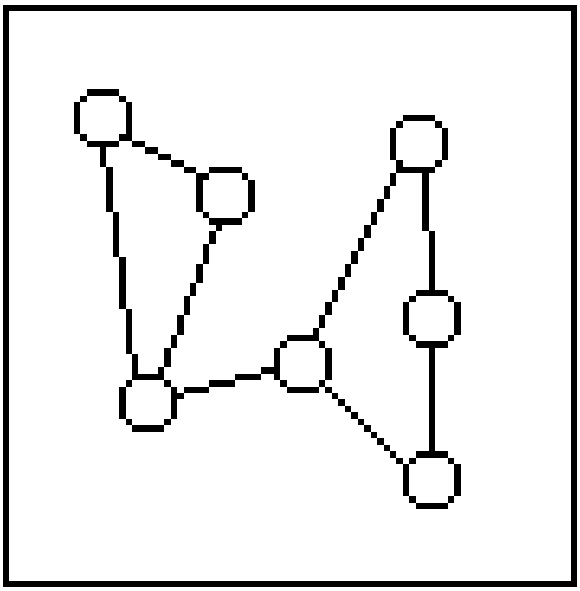
This tool takes large amounts of disorganized data and information and enables one to organize it into groupings based on natural relationships.



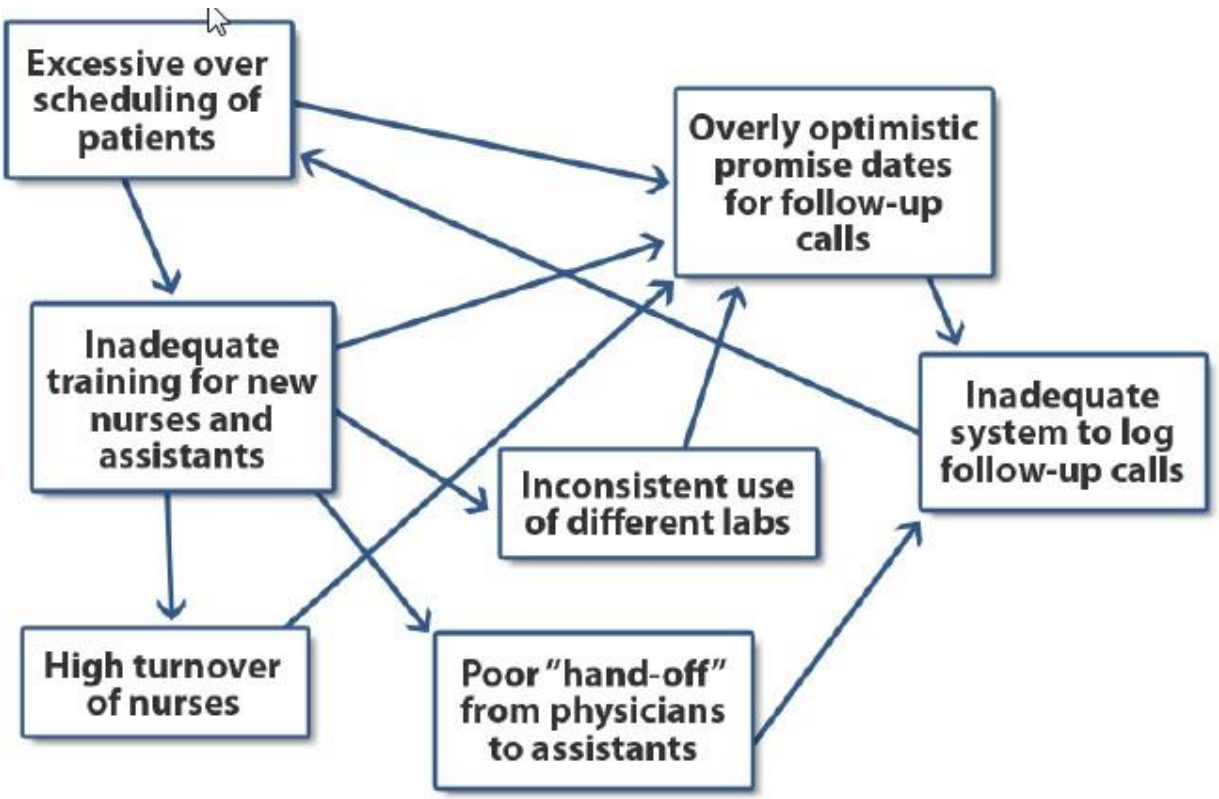


Interrelationship Digraph

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

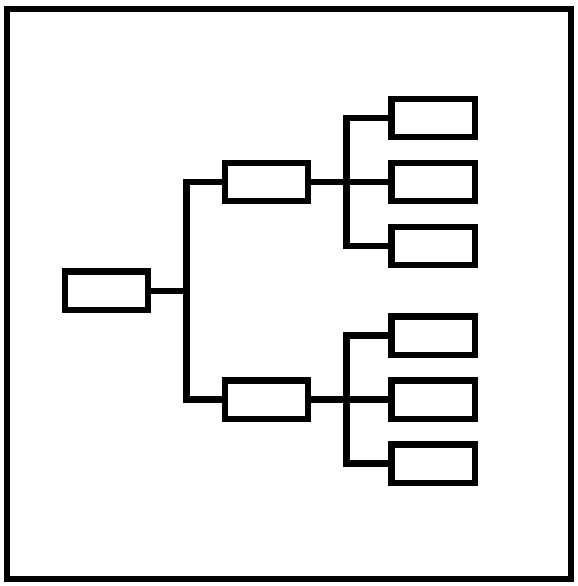


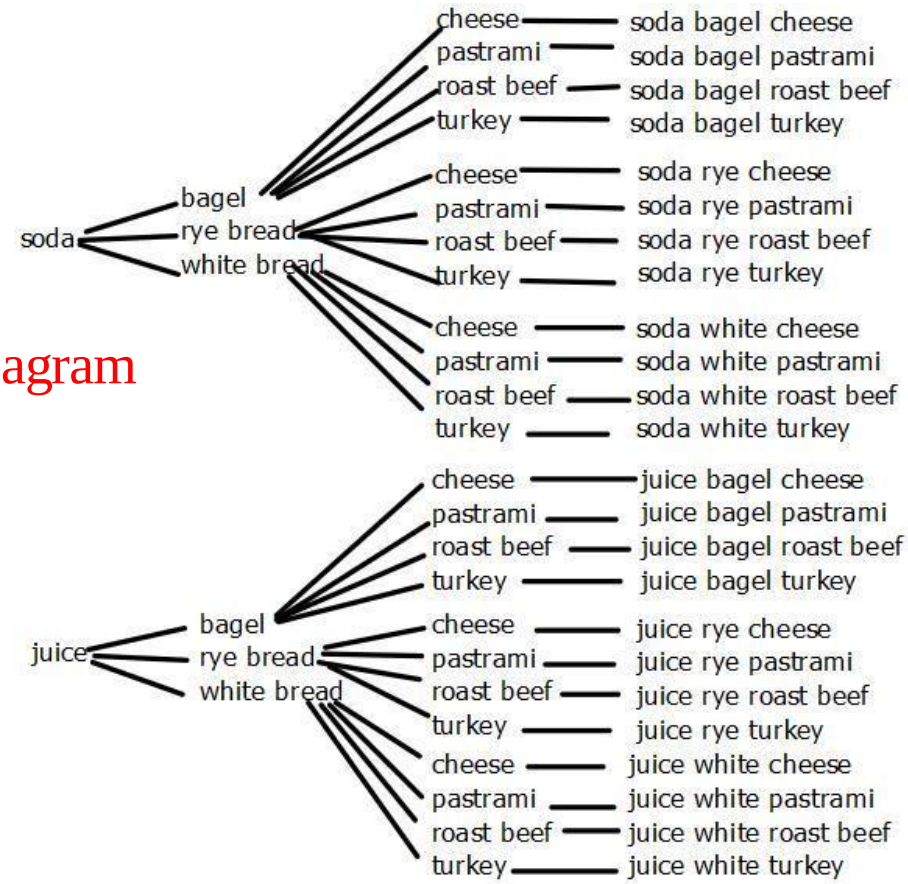
Interrelationship Digraph



Tree Diagram

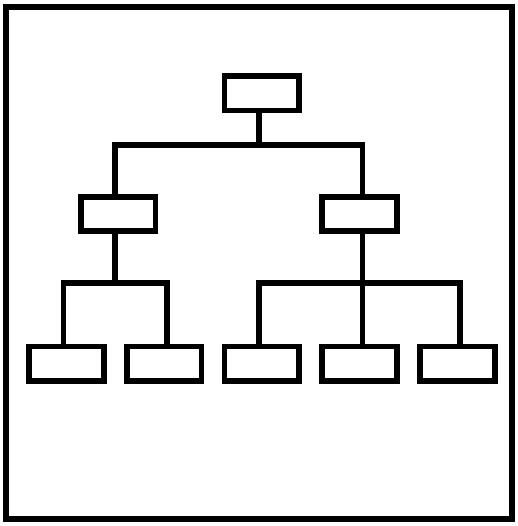
This tool is used to break down broad categories into finer and finer levels of detail. It can map levels of details of tasks that are required to accomplish a goal or task.





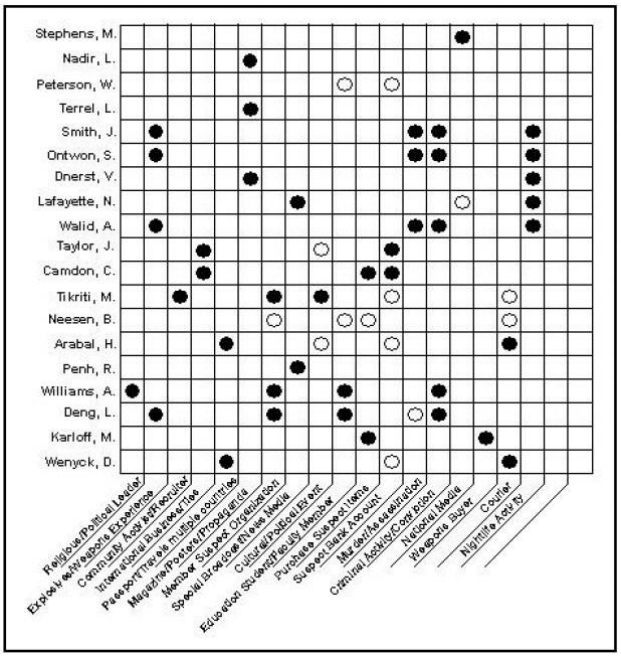
Process Decision Program Chart (PDPC)L

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.



Matrix Diagram

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



Matrix Data Analysis

Principal Component Analysis

- Technique quantifies and arranges data presented in Matrix
- Based solely on numerical data
- Finds indicators that differentiate and attempt to clarify large amount of information

Completing a Prioritization Grid

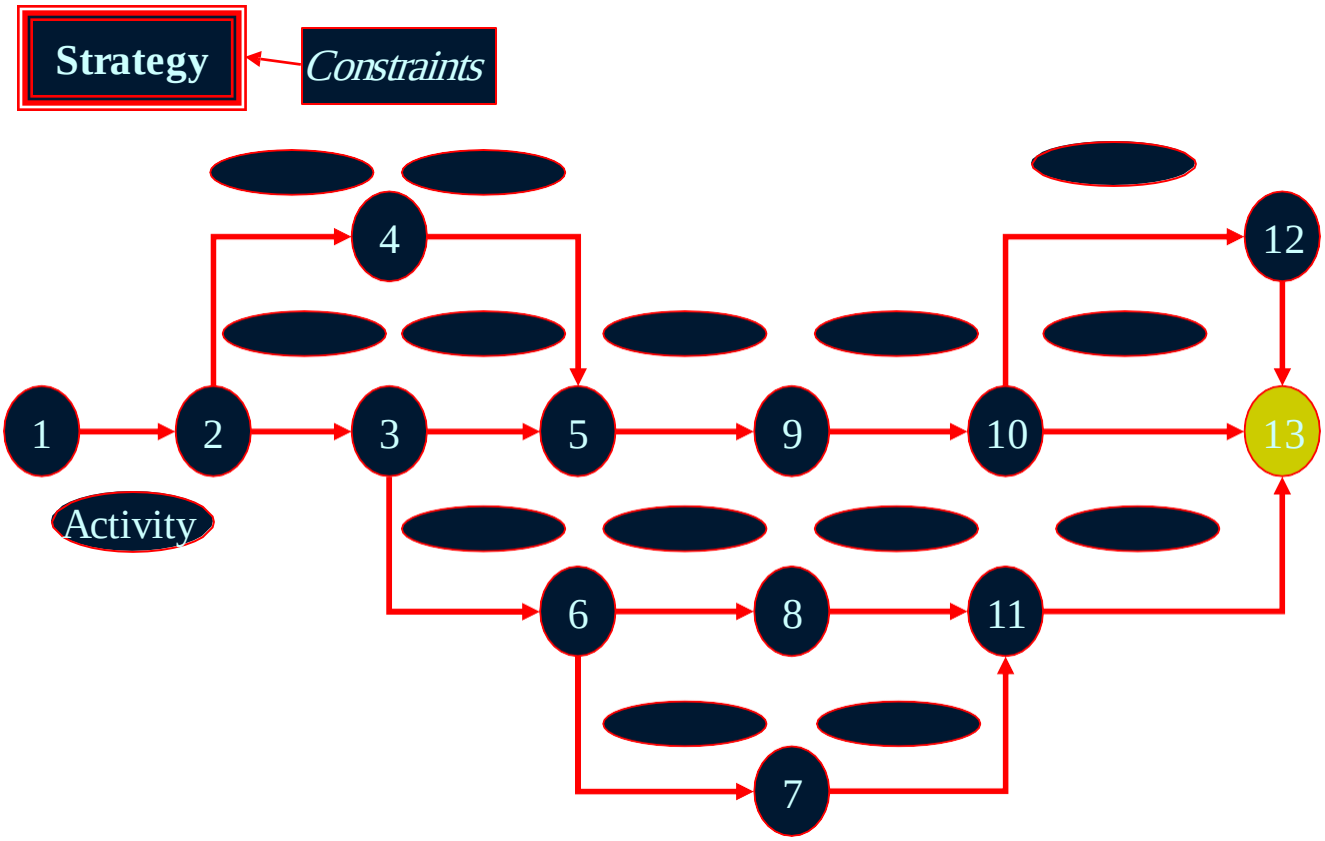
Criteria	Customer Acceptance (most important)	Cost	Reliability	Strength (least important)	Importance Sum Score	Option Ranking
Options						
Design A						
Percentage weight	.40	.30	.20	.10		
Rank	4	3	3	1		
Importance score	1.6	.90	.60	.10	3.2	1(tie)
Design B						
Percentage weight	.30	.40	.10	.20		
Rank	3	4	1	2		
Importance score	.90	1.6	.10	.40	3.0	2
Design C						
Percentage weight	.25	.25	.25	.25		
Rank	1	2	4	3		
Importance score	.25	.50	1	.75	2.5	3
Design D						
Percentage weight	0.3	.10	.20	.40		
Rank	3	1	3	4		
Importance score	.90	.10	.60	1.6	3.2	1(tie)
Sum of weights	125	105	.75	.95		
Average weight	.31	.26	.19	.24		
Criterion Ranking	1	2	4	3		

Arrow Diagrams

For Working Out Optimal Schedules and

Controlling Them Effectively

- Shows relationships among tasks needed to implement a plan
- Network technique using nodes for events and arrows for activities
- Used in PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method)



CHAPTER.3

Tools for organizations and analysis of data , tools for determine and solving problems
(control charts for variables – control charts for attributes – PRE - control – analysis – flow charts)

Control Charts

- Definition:

  - A statistical tool to determine if a process is in control.

Two Types of Control Charts

Variable Control Charts

Attribute Control Charts

Variable Control Charts

Deal with items that can be measured .

Examples

1) Weight

2) Height

3) Speed

4) Volume

Types of Variable Control Charts

X-Bar chart

R chart

MA chart

Variable Control Charts

- X chart: deals with a average value in a process
- R chart: takes into count the range of the values
- MA chart: take into count the moving average of a process

Attribute Control Charts

Control charts that factor in the quality attributes of a process to determine if the process is performing in or out of control.

Types of Attribute Control Charts

P chart

C Chart

U Chart

Attribute Control Charts

P Chart: a chart of the percent defective in each sample set.

C chart: a chart of the number of defects per unit in each sample set.

U chart: a chart of the average number of defects in each sample set.

Reasons for using Control Charts

Improve productivity

Make defects visible

Determine what process adjustments need to be made

Determine if process is “in” or “out of control

Control Chart Key Terms

- Out of Control: the process may not perform correctly
- In Control: the process may be performing correctly
- UCL: upper control limit
- LCL: lower control limit
- Average value: average

Process is OUT of control if:

One or multiple points outside the control limits

Eight points in a row above the average value

Multiple points in a row near the control limits

Process is IN control if:

The sample points fall between the control limits

There are no major trends forming, i.e.. The points vary, both above and below the average value.

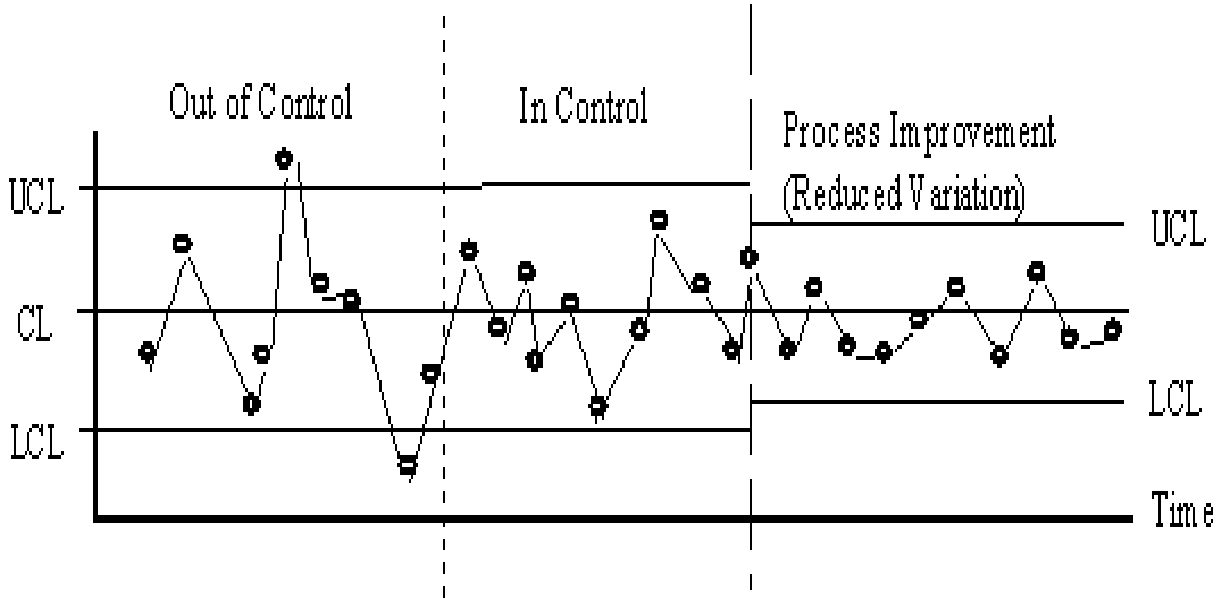
Calculating Major Lines in a Control Chart

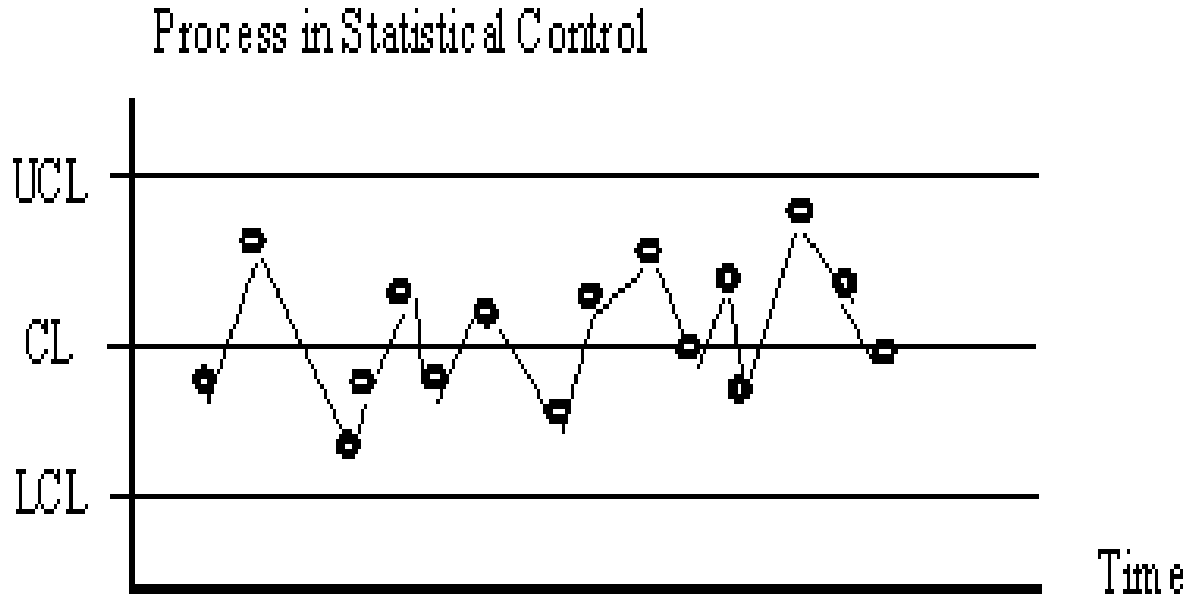
Average Value: take the average of the sample data

UCL: Multiply the Standard deviation by three. Then add that value to the Average Value.

LCL: Multiply the Standard deviation by three. Then subtract that value from the Average Value.

Examples of Control Charts





How to Calculate the standard deviation

- P chart:
  - P= percent or rate
- N= number of trails

C chart:

X= the average

$$\sigma = \sqrt{\frac{\bar{p}(1-\bar{p})}{N}}$$

How to Calculate the control limits

- X-bar Chart:

Lower Control Limit:

- $\frac{\text{Mean} - 3*\text{sigma}}{n(1/2)}$

Center Line:

- Process mean

$$\sigma = \sqrt{\bar{x}}$$

Upper Control Limit:

- $\frac{\text{Mean} + 3*\text{sigma}}{n(1/2)}$

- R chart:
    - Lower Control Limit:
        - R-Bar – 3*d3*sigma
    - Center Line:
        - R-Bar
    - Upper Control Limit:
- R-Bar + 3*d3*sigma

Sample Size

The sample set of data should be greater than 28.

The data should have been collected uniformly

The data should contain multiple capable points of data, or the information is incorrect.

3.2 international standards accreditation meaning ,ISO requirements and recommendations:

international standards accreditation meaning:

Quality management

- ISO 9001 is for **quality management**.
- **Quality** refers to all those features of a product (or service) which are required by the customer.
- **Quality management** means what the organization does to
- ensure that its products or services satisfy the customer's **quality requirements** and
- comply with any **regulations** applicable to those products or services.
- Quality management also means what the organization does to
- enhance customer satisfaction, and
- achieve continual improvement of its performance.

Generic standards

ISO 9001 and ISO 14001 are generic standards.

Generic means that the same standards can be applied:

to any organization, large or small, whatever its product or service,

in any sector of activity, and

whether it is a business enterprise, a public administration, or a government department

Generic also signifies that

- no matter what the organization's scope of activity
- if it wants to establish a **quality management system**, ISO 9001 gives the essential features
- or if it wants to establish an **environmental management system**, ISO 14001 gives the essential features.

Management system:

- Management system means what the organization does to manage its processes, or activities in order that
- its products or services meet the organization's objectives, such as
- satisfying the customer's quality requirements,
- complying to regulations, or
- meeting environmental objectives
- To be really efficient and effective, the organization can manage its way of doing things by systemizing it.
- Nothing important is left out.
- Everyone is clear about who is responsible for doing what, when, how, why and where.
- Management system standards provide the organization with an international, state-of-the-art model to follow.

- Large organizations, or ones with complicated processes, could not function well without management systems.
- Companies in such fields as aerospace, automobiles, defense, or health care devices have been operating management systems for years.
- The **ISO 9001** and **ISO 14001** management system standards now make these successful practices available **for all organizations**.

Certification and registration

- Certification is known in some countries as registration.
- It means that an independent, external body has audited an organization's management system and verified that it conforms to the requirements specified in the standard (ISO 9001 or ISO 14001).
- ISO does not carry out certification and does not issue or approve certificates,

Accreditation

- Accreditation is like certification of the certification body.
- It means the formal approval by a specialized body - an accreditation body - that a certification body is competent to carry out ISO 9001:2008 or ISO 14001:2004 certification in specified business sectors.
- Certificates issued by accredited certification bodies - and known as accredited certificates - may be perceived on the market as having increased credibility.
- ISO does not carry out or approve accreditations.

Certification not a rééquipement

- **Certification is not a requirement of ISO 9001 or ISO 14001.**
- The organization can implement and benefit from an ISO 9001 or ISO 14001 system without having it certified.
- The organization can implement them for the **internal benefits** without spending money on a certification programme.
- Certification is a decision to be taken for business reasons:
- if it is a contractual, regulatory, or market requirement,
- If it meets customer preferences
- it is part of a risk management programme, or
- if it will motivate staff by setting a clear goal.
- ISO does not carry out ISO 9001 or ISO 14001 certification.
- ISO does not issue certificates.
- ISO does not accredit, approve or control the certification bodies.
- ISO develops standards and guides to encourage good practice in accreditation and certification.

The ISO family

- **ISO 9001** is the standard that gives the requirements for a **quality management system**.
- **ISO 9001:2008** is the latest, improved version.
- It is the **only standard** in the ISO 9000 family that can be used for **certification**.
- There are **16 other standards** in the family that can help an organization on specific aspects such as performance improvement, auditing, training…
- ISO 14001 is the standard that gives the requirements for an environmental management system.
- ISO 14001:2004 is the latest, improved version.
- It is the only standard in the ISO 14000 family that can be used for certification.
- The ISO 14000 family includes 21 other standards that can help an organization specific aspects such as auditing, environmental labelling, life cycle analysis…

3.3Audit program

A. Design of the Audit Program

Most audits design an audit program in the following three parts

A. Tests of Controls and Substantive Tests of Transactions

B. Analytical Procedures

C. Tests of Details of Balances

A. Tests of Controls and Substantive Tests of Transactions

A four-step approach when the auditor plans to reduce assessed control risk below the maximum:

- ✓ Transaction related audit objectives are applied to the class of transactions being tested, such as sales.
- ✓ Key controls that should reduce control risk for each transaction-related audit objective are identified.
- ✓ For all internal controls used to reduce the initial assessment of control risk below the maximum (key controls), appropriate tests of controls are developed.
- ✓ Design appropriate substantive tests of transactions, considering weaknesses in internal control and expected results of tests of controls (allows for simultaneous tests of controls and substantive testing).

B. Analytical Procedures

Analytical procedures may be performed during 3 different stages of the audit:

- ❖ **In the planning stage to help the auditor understand the client's business and determine other evidence needed to satisfy acceptable audit risk.**
- ❖ **During the audit, especially during substantive testing.**
- ❖ **Near the end of the audit as a final test of reasonableness**

C. Tests of Details of Balances

If the results of tests of controls, substantive tests of transactions, and analytical procedures are not consistent with the predictions, tests of details of balances will need to be changed as the audit progresses.

Summary of the Audit Process - Phase I (Planning)

Accept client and perform initial planning.

Understand the client's business and industry.

Assess client's business risk.

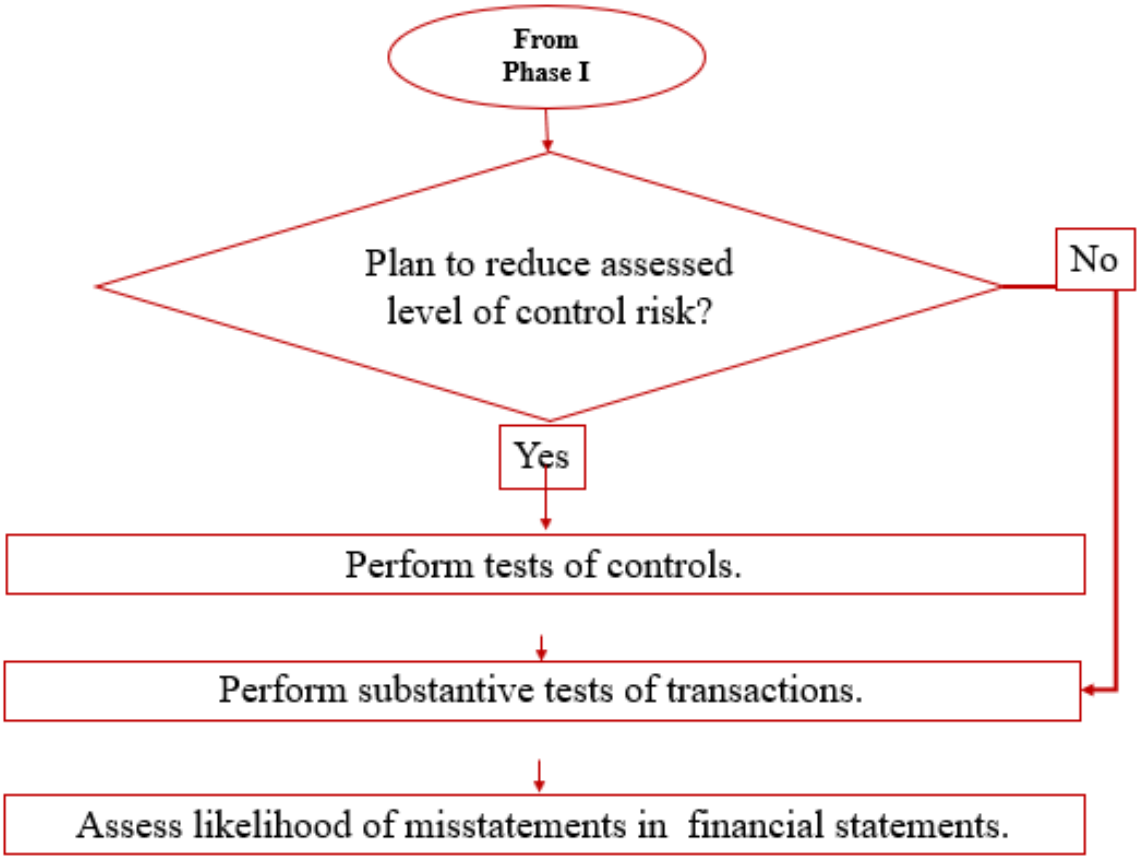
Perform preliminary analytical procedures.

Set materiality and assess acceptable audit risk and inherent risk.

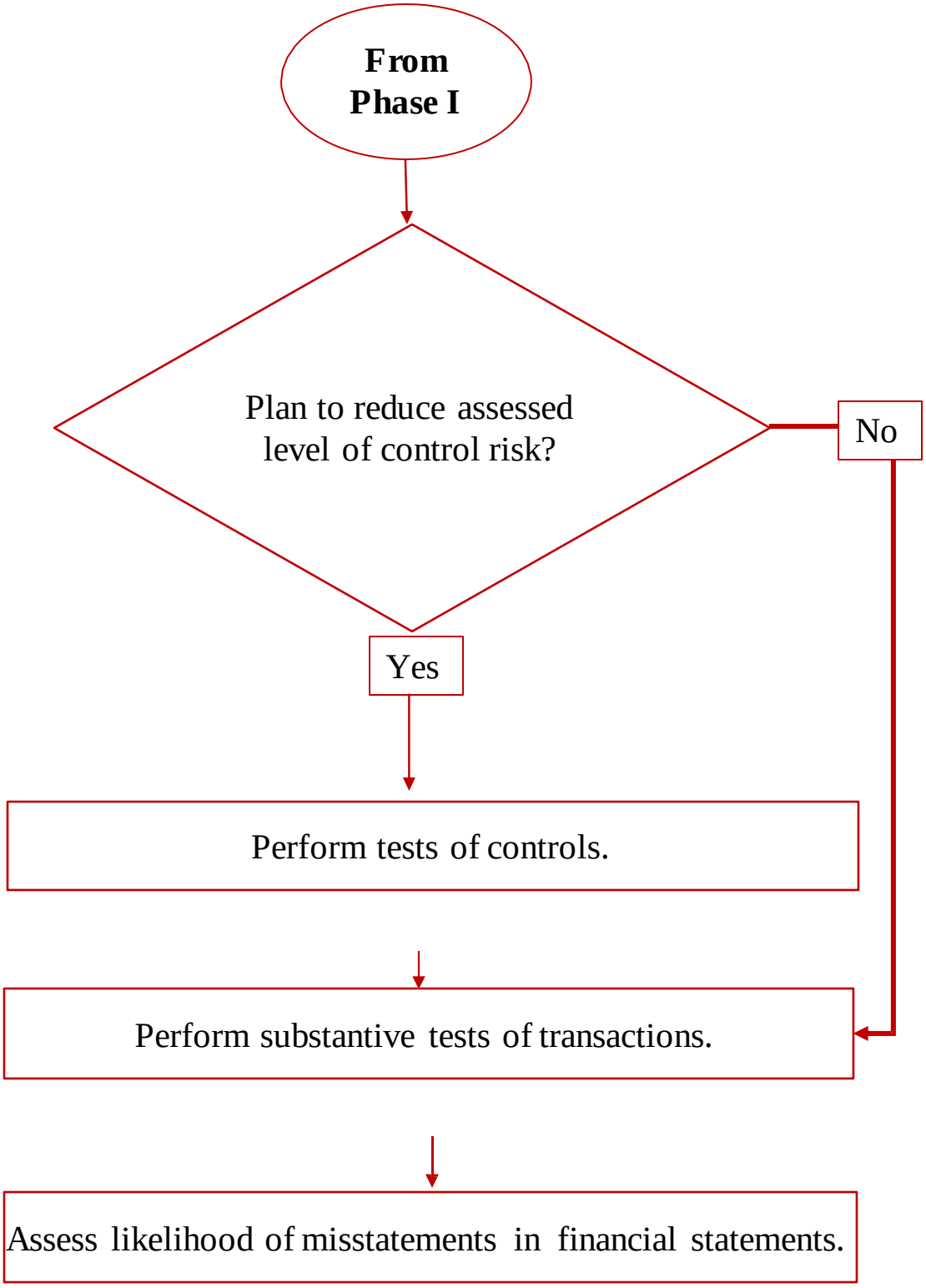
Understand internal control and assess control risk.

Develop overall audit plan and audit program.

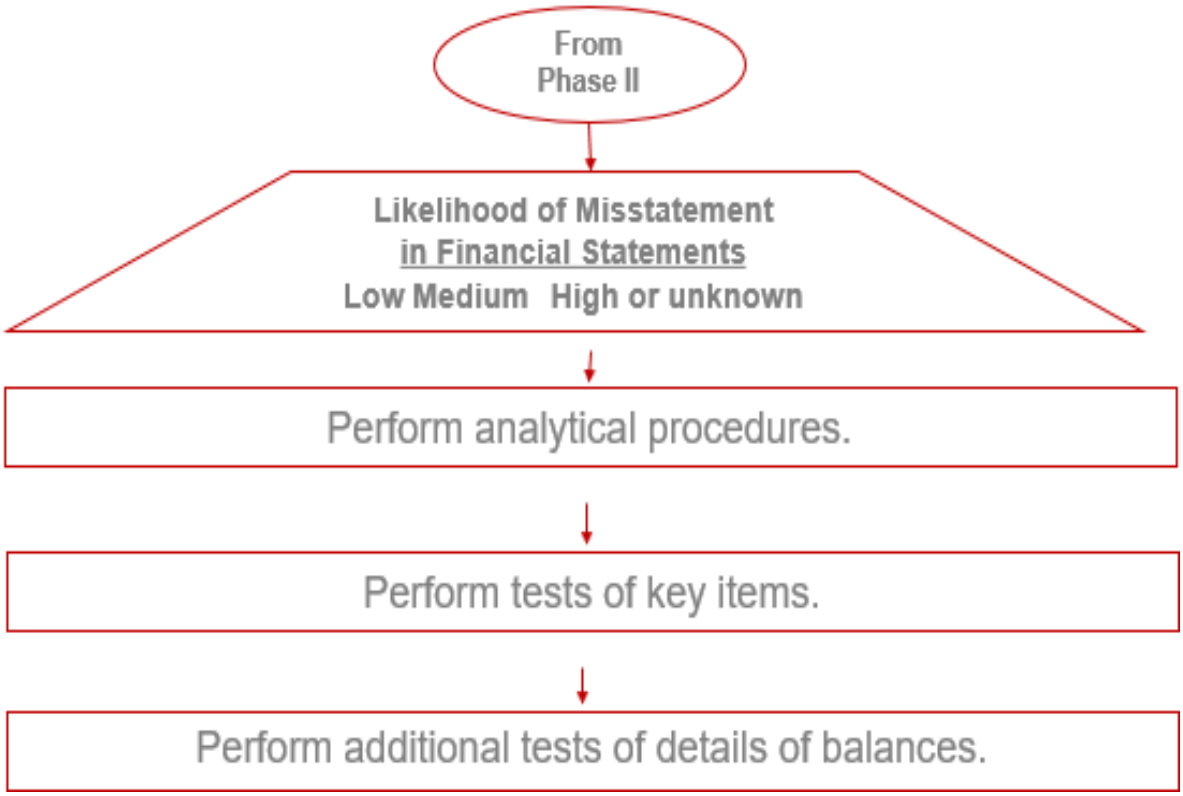
Summary of the Audit Process - Phase II (Begin Field Work)



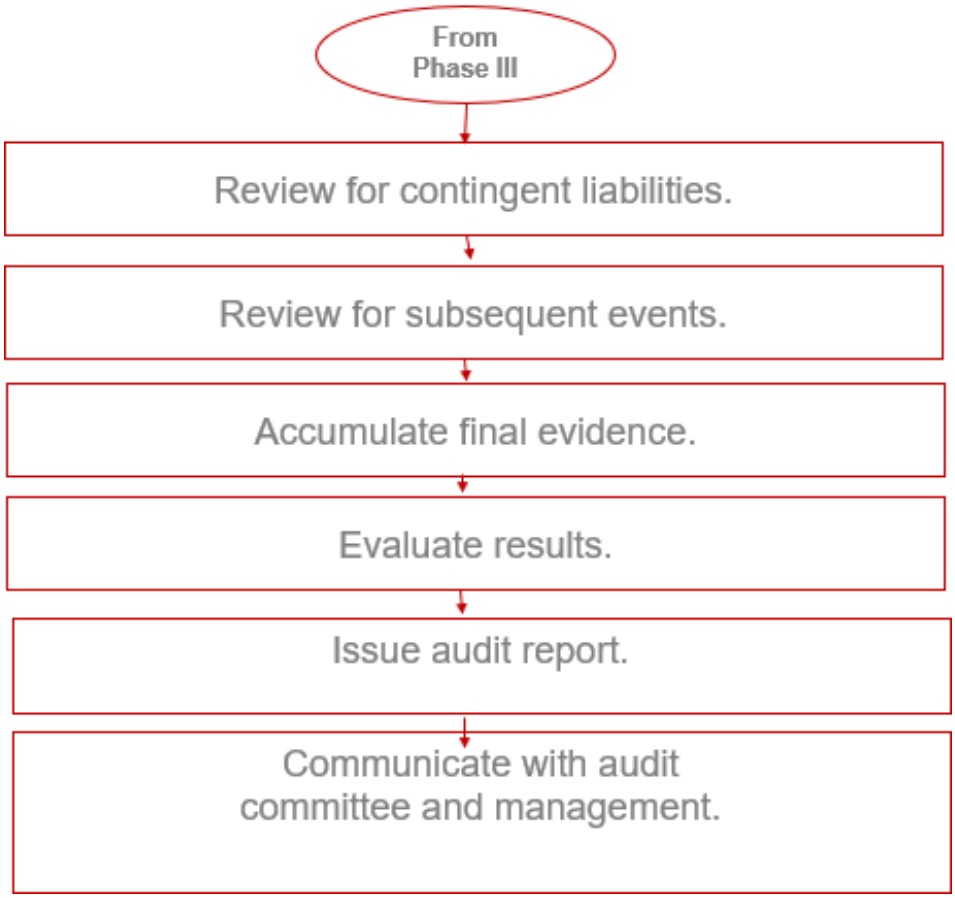
Summary of the Audit Process - Phase II (Begin Field Work)



Summary of the Audit Process Phase III (End of Fieldwork)



Summary of the Audit Process Phase IV (Wrap-Up)



Analyzing process capability indices , process performance indices:

? Process capability: ability of the process to realize a characteristic that will fulll the requirements for that characteristic. (ISO 25517-4)

Speciation: an explicit set of requirements to be satisfied by a material, product or service. Speciation are mandatory if adopted by a business contract. Speciation must be respected to avoid sanctions.

Process Capability Analysis:

The capability analysis is carried out in the following steps:

For the capability analysis to be performed the process needs to be under statistical control.

- Specification limits can be: the Upper Specification Limit (USL), the Lower Specification Limit (LSL) and eventually a target value. Specification limits are usually provided from outside (production requirements, market requirements). Specification can either be two-sided (when USL and LSL are both specified) or one-sided (either USL or LSL is specified).

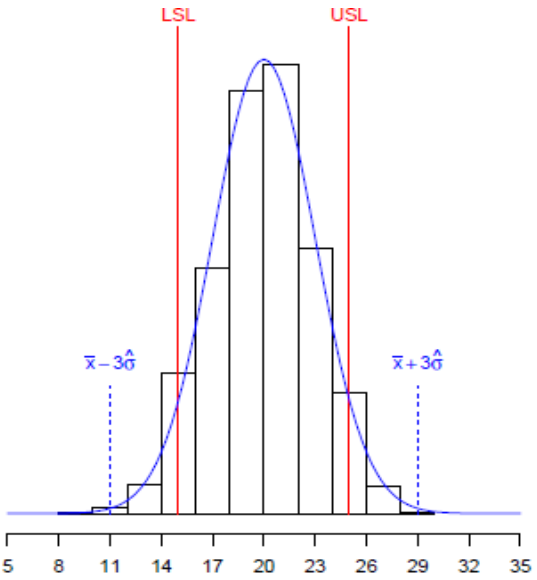
select the process to be analysed and collection of data; identify specific limits according to which capability analysis will be evaluated; verify the process is under statistical control;

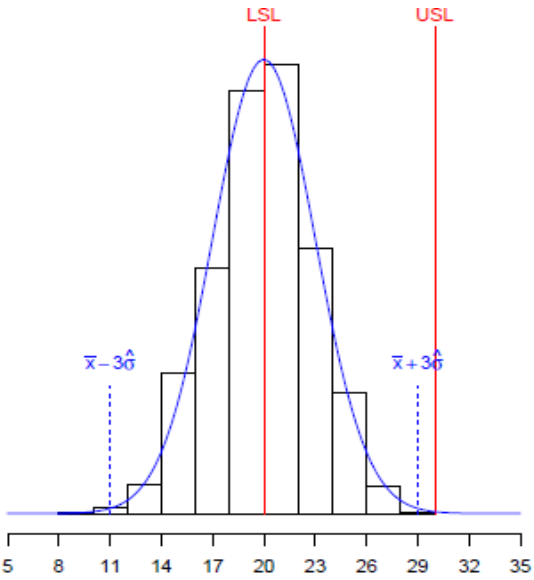
analyse data distribution; estimate capability indices.

- To sum up, a process is capable when:
  - it is under statistical control;
  - it has a low variability rate compared to the range of specified limits;
  - process distribution is possibly centered on specification limits (centering).

- If a process respects specifications and is under statistical control it can be foreseen that specifications will not change in the future. If a process respects specifications but is not under statistical control, specification could change in the future.

- Process variability indicates the spread within which 99.73% of the process distribution is contained. A normal distribution has a 6σ width range centered on the mean ($\mu \pm 3\sigma$).





The two distributions have the same characteristics as far as shape, position and dispersion are concerned. The limit spread is the same. The process on the right is not centered with respect to its specification limits. Therefore process capability on the right will be lower.

Process Capability

- Process limits (The "Voice of the Process" or The "Voice of the Data") - based on natural (common cause) variation

- Tolerance limits (The "Voice of the Customer") – customer requirements

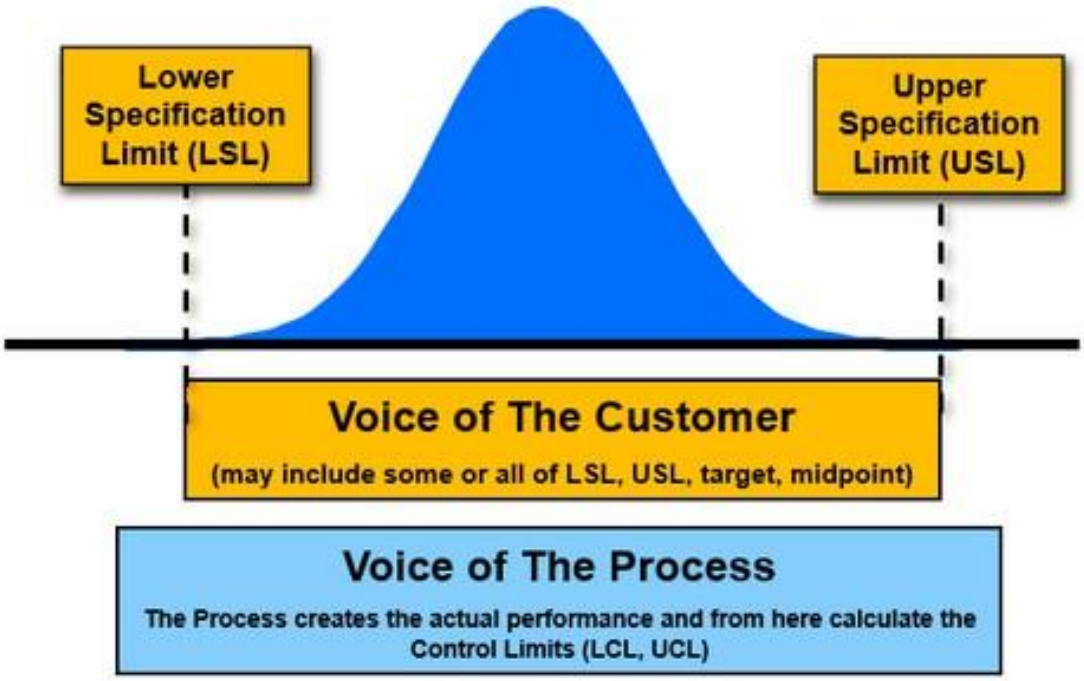
- Process Capability – A measure of how "capable" the process is to meet customer requirements; compares process limits to tolerance limits

Process Capability Index

where x-bar is the mean of the process, sigma is the standard deviation of the process, UTL is the customer's upper tolerance limit (specification), and LTL is the customer's lower tolerance limit.

$$C_{pk} = \min\left(\left|\frac{\bar{X} - LTL}{3\sigma} \text{ or } \frac{UTL - \bar{X}}{3\sigma}\right|\right)$$

Process Capability Indices



Goal is to shift the process to a target (which may not be a midpoint) and reduce the spread (variation) to meet the customer specifications. Accuracy + Precision

$$C_{pk} = \min\left(\left|\frac{\overline{X} - LTL}{3\sigma} \text{ or } \frac{UTL - \overline{X}}{3\sigma}\right|\right)$$

Quality gurus

Dr. W. Edward Deming (1900–1993)

- Deming began teaching the quality improvement with Japanese industry.
- He received National Medal of Technology from U. S. in 1946.
- Deming is best known for improving the systems so that workers can do their jobs more effectively.

Dr. W. Edward Deming (1900–1993)

- The improvements in quality lead to:

lower costs and higher productivity

- Because they result in less rework, fewer mistakes, fewer delays, and better use of time.
- Then a firm can achieve a greater market

Dr. W. Edward Deming (1900–1993)

- Deming's philosophy is summarized in his **famous fourteen points**, and it serves as a framework for quality and productivity improvement.
- Study of highly successful companies shows that Deming philosophy leads to significant improvements, and these 14 points have become a standard reference for quality transformation.

Dr. W. Edward Deming (1900–1993)

1. Create continuous of improvement for product and service.
2. Adopt the new philosophy, We must prevent mistakes.
3. Inspection should be used as an information-gathering device, not as blaming workers.
4. Don't award business on price tag alone (but also on quality, value, speed and long term relationship).

Dr. W. Edward Deming (1900–1993)

Deming's 14 points:

12. Remove barriers that hinder workers.
13. Institute a active program for education and self improvement.
14. Take action to accomplish the transformation.

Dr. W. Edward Deming (1900–1993)

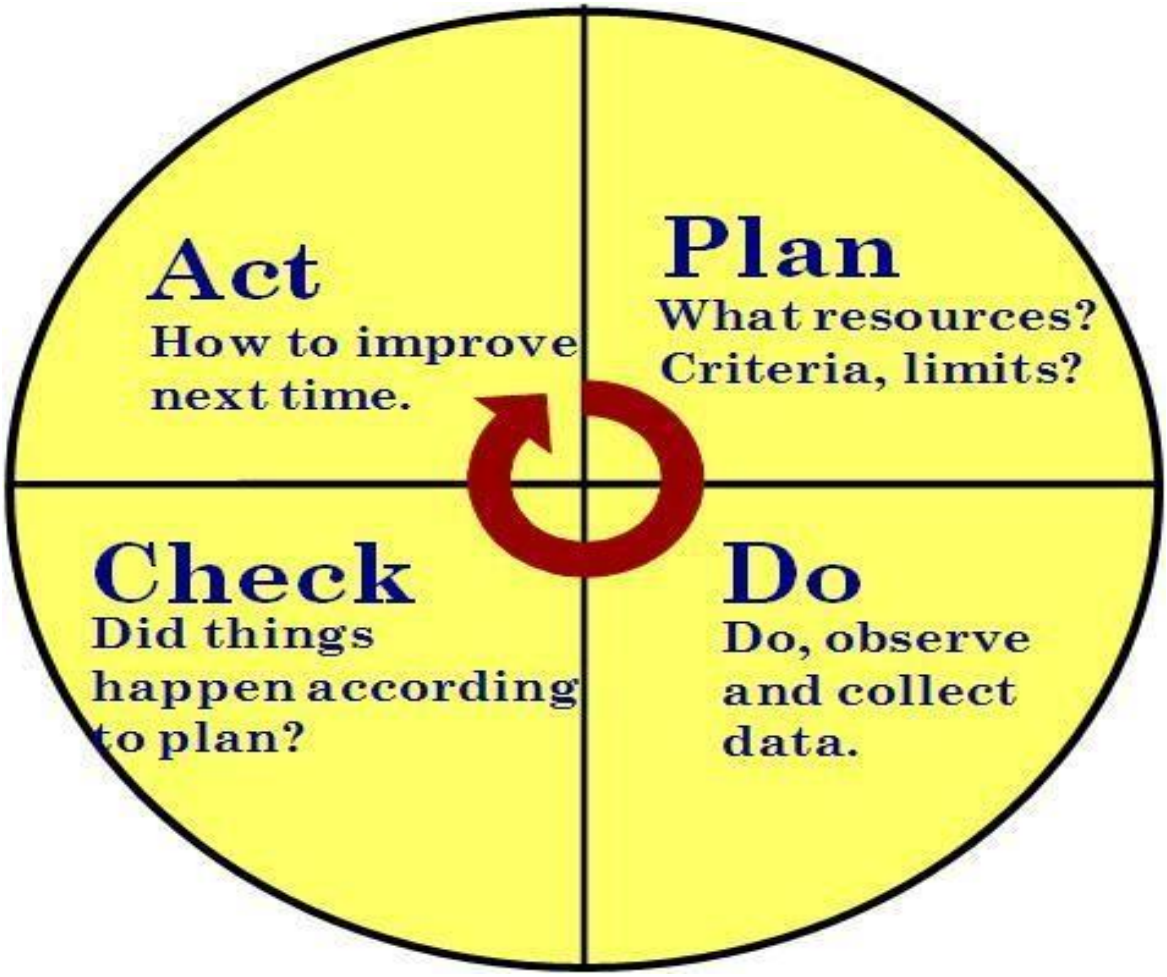
Deming's 14 points:

5. Continuously improve of the system.
6. Institute training on the job. When training is an integral part of the system, operators are better able to prevent defects.
7. Institute leadership. The best supervisors are leaders and coaches, not dictators.
8. Drive out fear. Create a fear-free environment where everyone can contribute and work effectively.

Dr. W. Edward Deming (1900–1993)

Deming's 14 points:

9. Break down barriers between areas. People should work cooperatively with mutual trust and respect, appreciation for the needs of others.
10. Eliminate slogans aimed solely at the work force. Most problems are system-related and require managerial involvement to change.
11. Eliminate numerical goals and quotas. Goals should be set in a participative style together.


Act
How to improve next time.
Plan
What resources? Criteria, limits?
Check
Did things happen according to plan?
Do
Do, observe and collect data.