

Lecture 3:

# Network Design Methodology



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# Network Design Methodology

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- Some design approaches:
  - Hierarchical model
  - PPDIOO (Prepare, Plan, Design, Implement, Operate, and Optimize, Cisco)
  - Eight Steps Design method

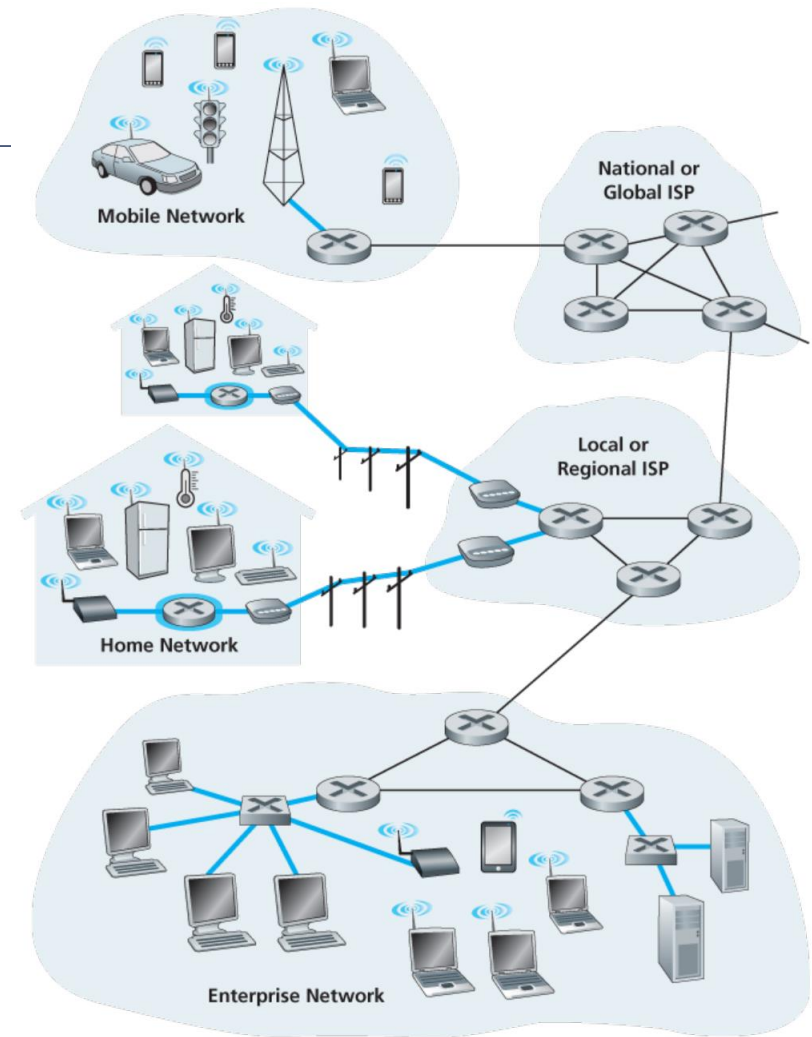
# Hierarchical model

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- Hierarchical network model includes three main layers:
  - **Core layer**: is the backbone layer of the network
  - **Distribution layer**: aggregate the networking traffic
  - **Access layer**: provides access to different network resources
- Advantages of this model:
  - Reducing the network complexity
  - Lower cost of implementation
  - Easy to understand, to grow and troubleshoot the network since each layer has each own functionality and features

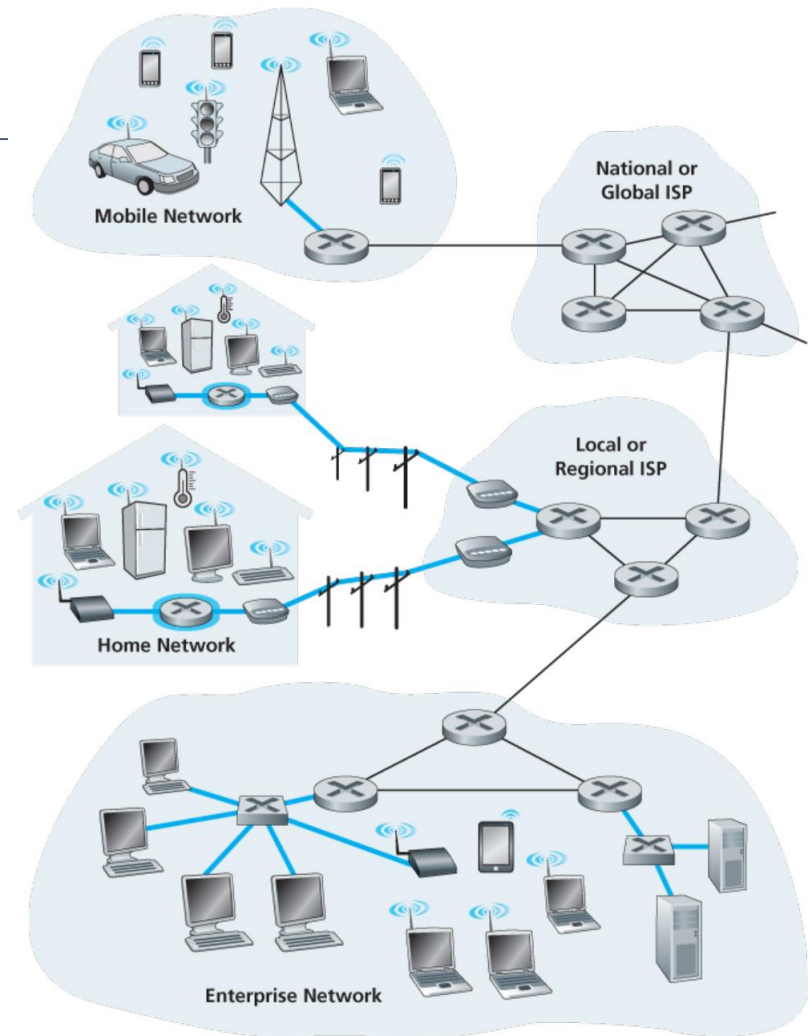
# Hierarchical model

- **Core layer** characteristics:
  - Fast transport
  - High reliability and availability
  - Low latency and good manageability
  - Fault tolerance
- **Core layer** devices:
  - High end routers and switches
  - Layer-3 switches
  - Gateways and media converters



# Hierarchical model

- **Access layer** provides access to different network services as PSTN (Public switch telephone network), WAN, DSL (Digital Subscriber line)
- **Access layer** characteristics:
  - High availability
  - Layer-2 switching
  - Port security
  - QoS classification



# PPDIOO (1/2)

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- It is the network life cycle which is defined by Cisco
- It has 6 phases: Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO)
  - ① Prepare: establishing the business goals and requirements
  - ② Plan: gathering information of all requirements, analyzing these requirements and plan to implement the best practices
  - ③ Design: including three main steps as identifying network requirements, characterizing the existing network, designing the network topology and solution

# PPDIOO (2/2)

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- It has 6 phases: Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO)
  - ④ Implementation: configuring and operating devices
  - ⑤ Operation: managing and monitoring the implemented network
  - ⑥ Optimization: modifying the network design if there are any problems. Then, you need to go back to the previous step and do the whole process again.

# Eight-step Design Methodology

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- ① Identify Customer requirements
- ② Describe the existing Network
- ③ Design networking & topology Solution
- ④ Plan the network implementation
- ⑤ Construct a prototype network
- ⑥ Fully document the Design
- ⑦ Implement the Design
- ⑧ Verify, monitor and modify as needed



# Eight-step Design Methodology

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- Step 1: Identify Customer requirements
  - Identify network applications and services
  - Define the organizational goals
  - Define the possible organizational constraints and limitations
  - Define technical goals
  - Define the possible technical constraints

# Eight-step Design Methodology

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- Step 2: describe the existing network
  - Identify all existing organization information and documentation to get:
    - Site names, site location, site contacts, cabling layout, etc.
    - Network infrastructure information: types and locations of network devices and servers, power usage, logical network information as network addressing, communication protocols, network management, or any security access control lists, etc.
  - Perform a network audit that adds detail to the description of the network by using network auditing tools and network analysis tools

# Eight-step Design Methodology

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- Step 3: design network topology and solutions
  - Select the network topology that allows you to develop an optimal solution with lower cost and fulfill all required goals as availability, flexibility, capacity, functionality, high performance, etc.
  - To design a network topology, you can use a top-down approach that uses the OSI (Open Systems Interconnection) model with 7 layers. It starts from the top layer which is related to the organization's requirements.

# Eight-step Design Methodology

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- Step 4: planning the network implementation
  - This step will produce the good documentation, diagram and other materials for the implementation process. The documents specifies step-by-step procedure of the implementation.
  - It also define a timeline for the whole network implementation as well as time frame for the implementation of each step.

# Eight-step Design Methodology

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- Step 5: constructing a prototype network
  - This step requires the good documentation, diagram and other materials. The documents should specify step-by-step procedure of the implementation.
  - It also requires a timeline for each step of the network implementation.

# Eight-step Design Methodology

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- Step 6: network design documentation
  - Documentation of any project are very important and has great benefits for the future use.
  - It can be used for checking the existing network.
  - It can also be beneficial for future improvement of the network.
  - The documentation may structure with 7 sections: *Introduction, Design Requirements, Existing Network Infrastructure, Network Design, Proof of Concept, Implementation Plan, and Appendixes.*

# Eight-step Design Methodology

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- Step 7: implement the design
  - This step brings the network diagram into the real network.
  - All materials produced in the previous steps would be used for this step.

# Eight-step Design Methodology

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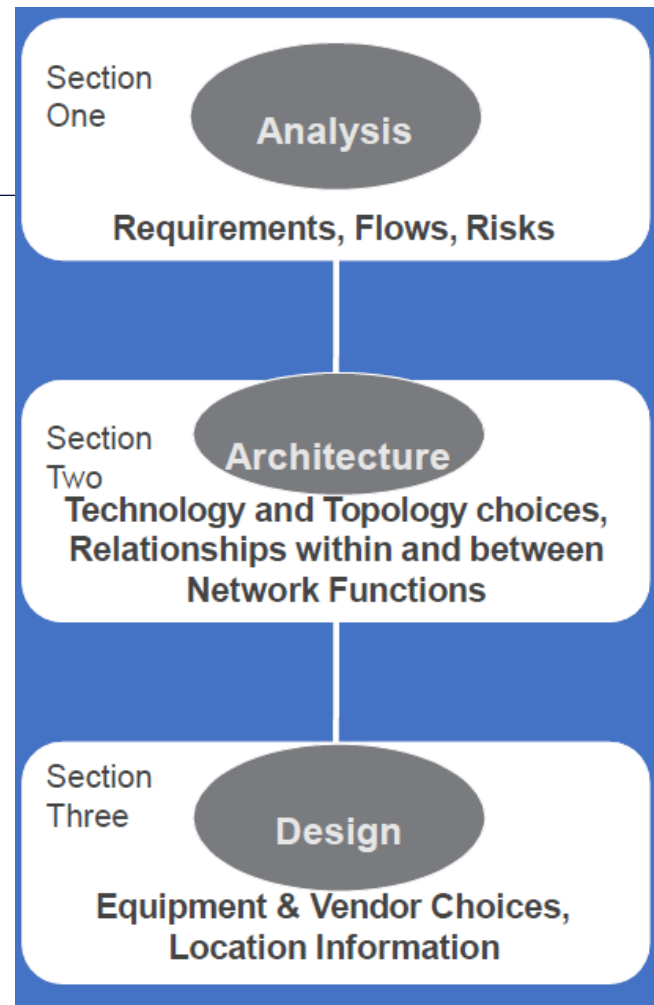
- Step 8: verify, monitor and modify as needed
  - Once, the network is fully implemented, you need to operate it properly and monitor its performance.
  - If the performance fails to meet the required goals, you can make the modification.
  - If more services need to be added, you can add them to the network.



# Network Design Process

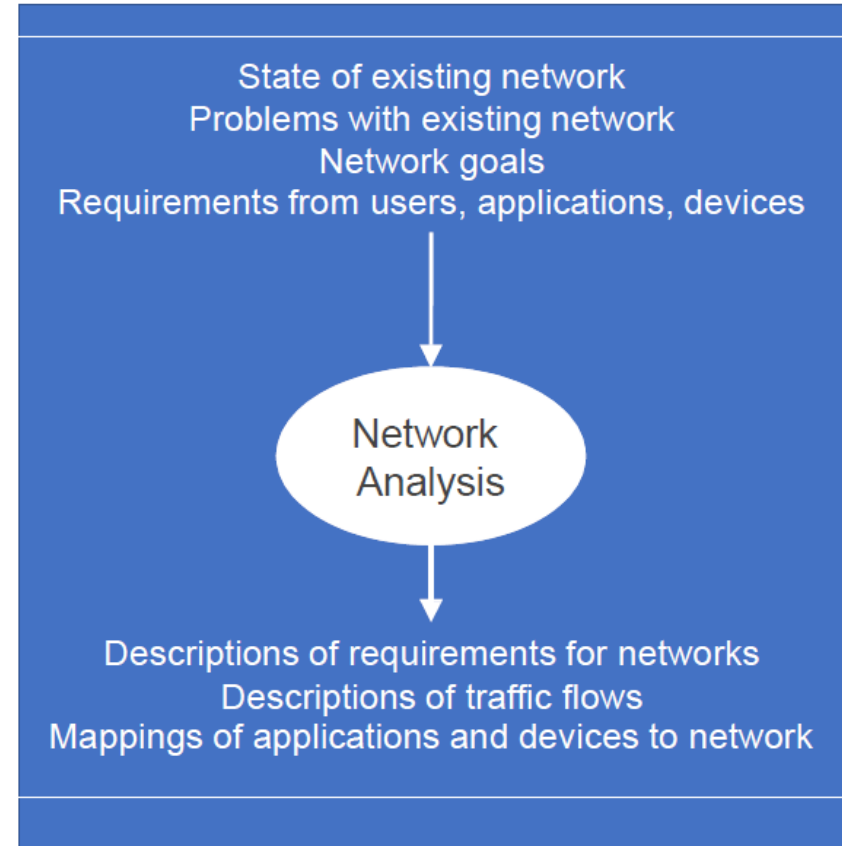
# Network Design Process

- Apply a system design methodology to the networking design.
- Information flows include three main processes:
  - Network analysis
  - Network architecture
  - Network design
- Together they help to identify and apply the services and performance levels required of the network.



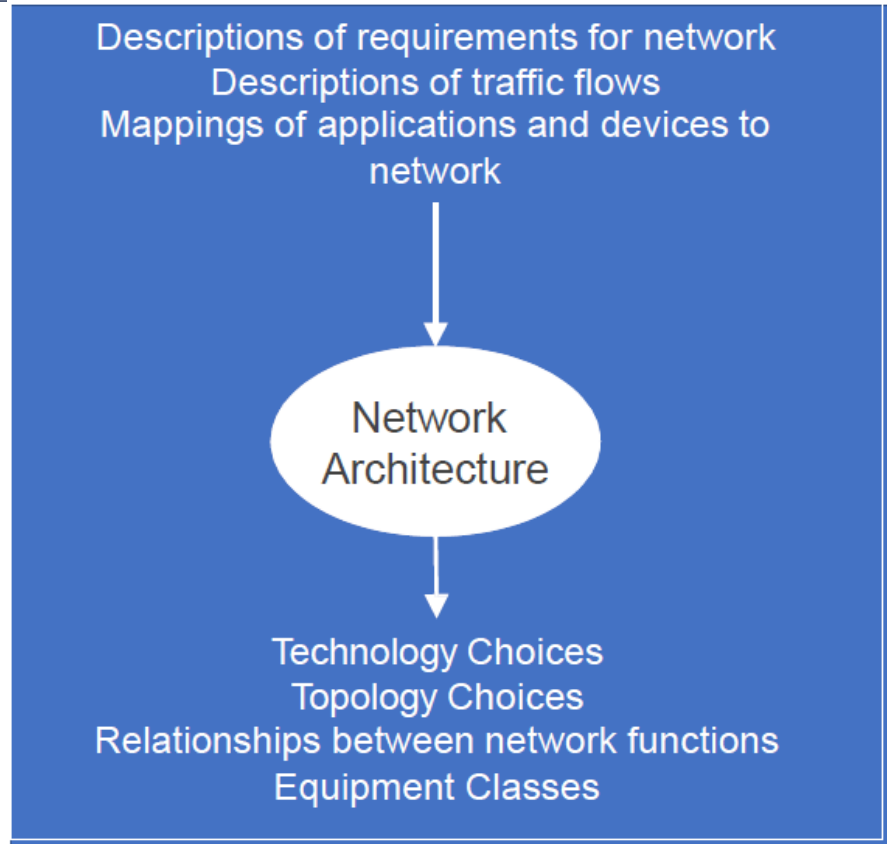
# Network Analysis

- Study of network components and their inputs and outputs to understand network behavior.
- Defines, determines and describes relationships between network components.



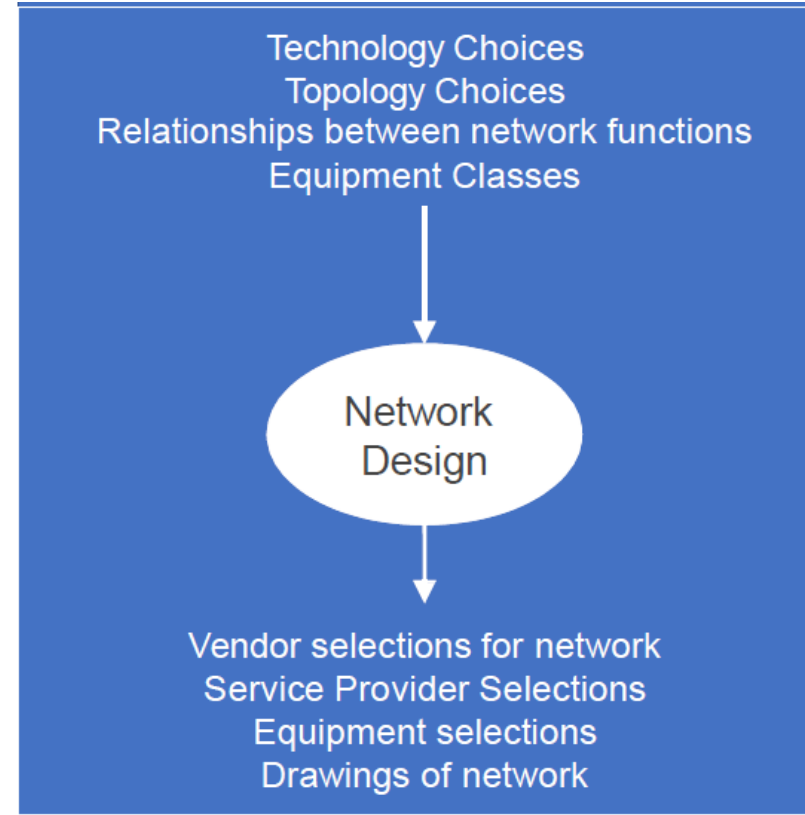
# Network Architecture

- Focus on finding the best network.
- Results include:
  - A reference architecture.
  - Descriptions of interactions, trade-offs, dependencies and constraints.



# Network Design

- Culmination of your work.
- Design goal: minimization of cost and maximization of performance:
  - Evaluation and choice of equipment
  - Choice of business partners



# Prior to Network Analysis

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- Defining scope
- Strategic network plan

# Defining scope

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- Identify the scope of the design is the initial and very important step of the network design.
- It is critical to determine:
  - If we design a green field (new) network
  - Or if the network is existing and it needs to be optimized, expanded, integrated with other external networks, etc.
- Defining the design scope will affect gathering information for the design.

# Strategic Network Plan



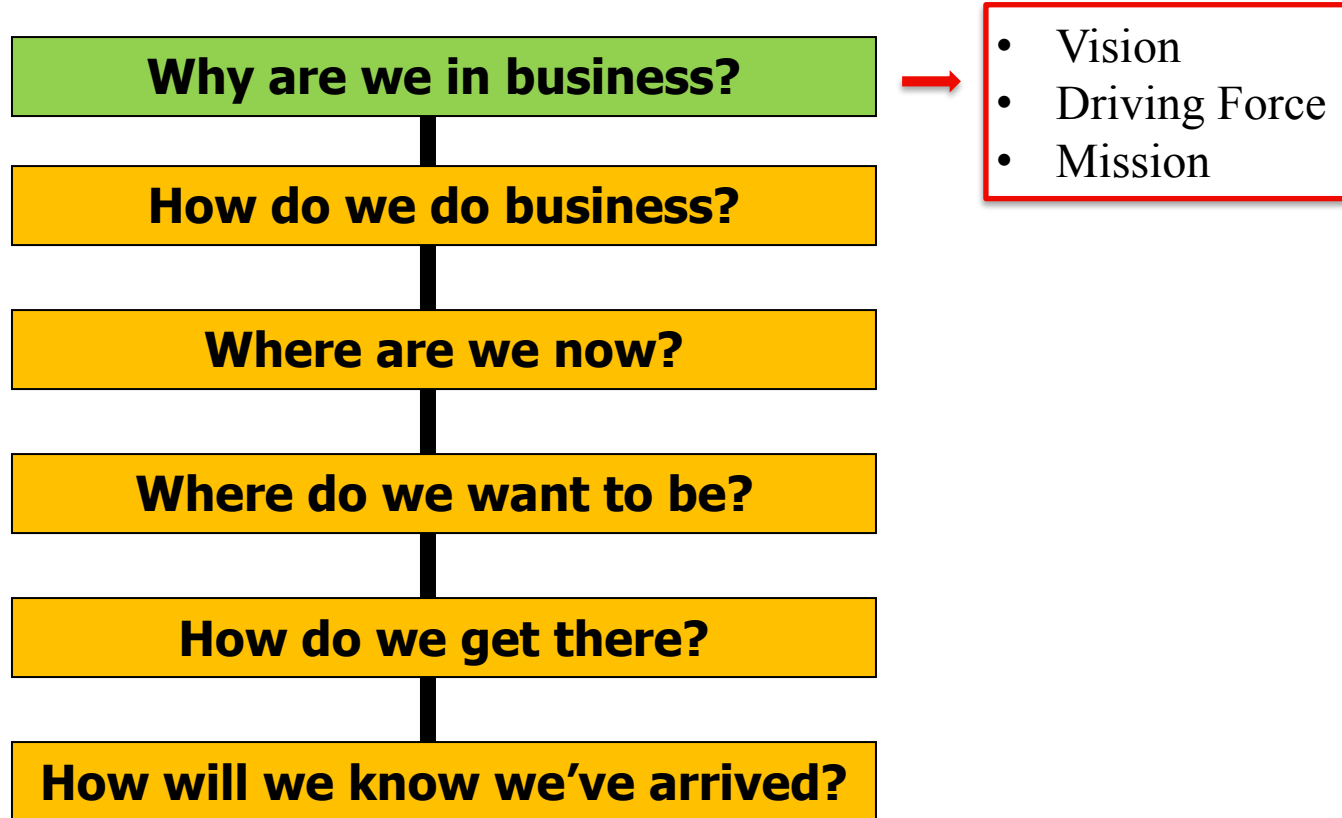
# The Crouch Diagram

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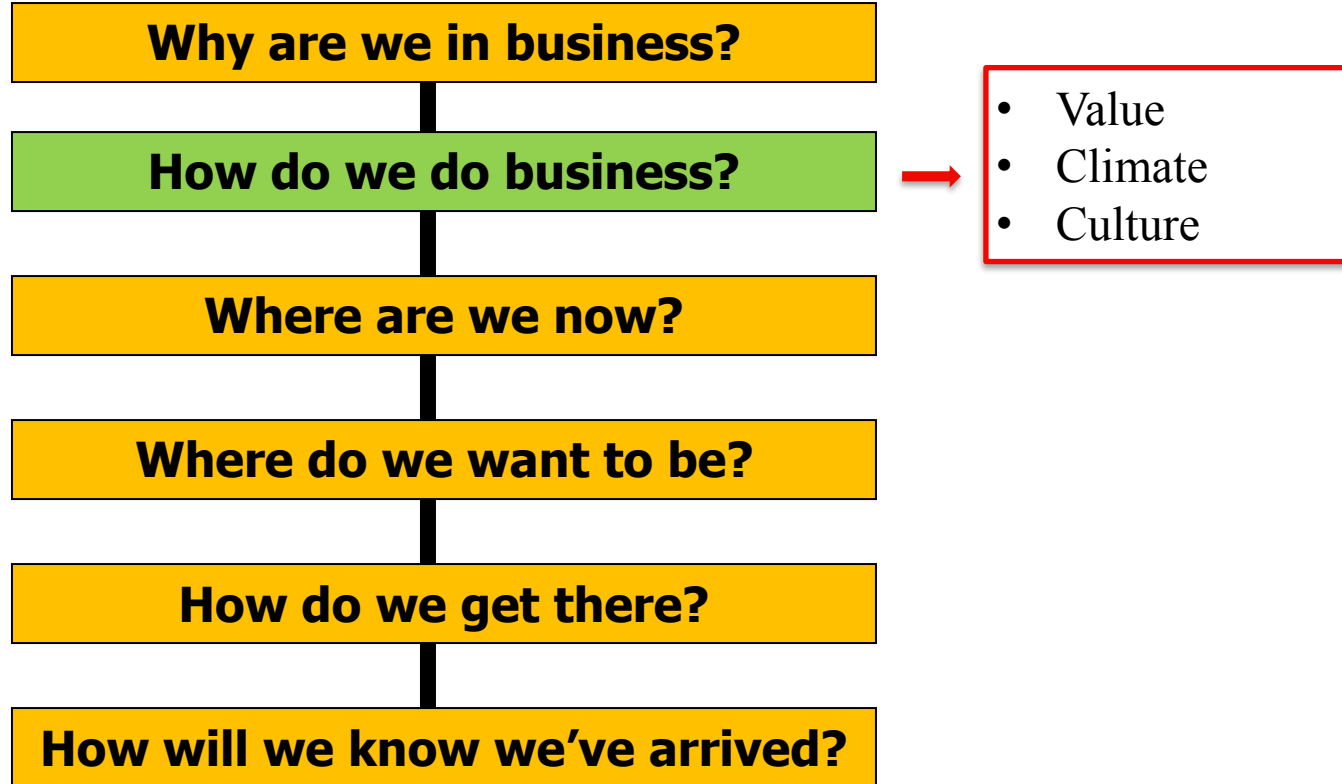
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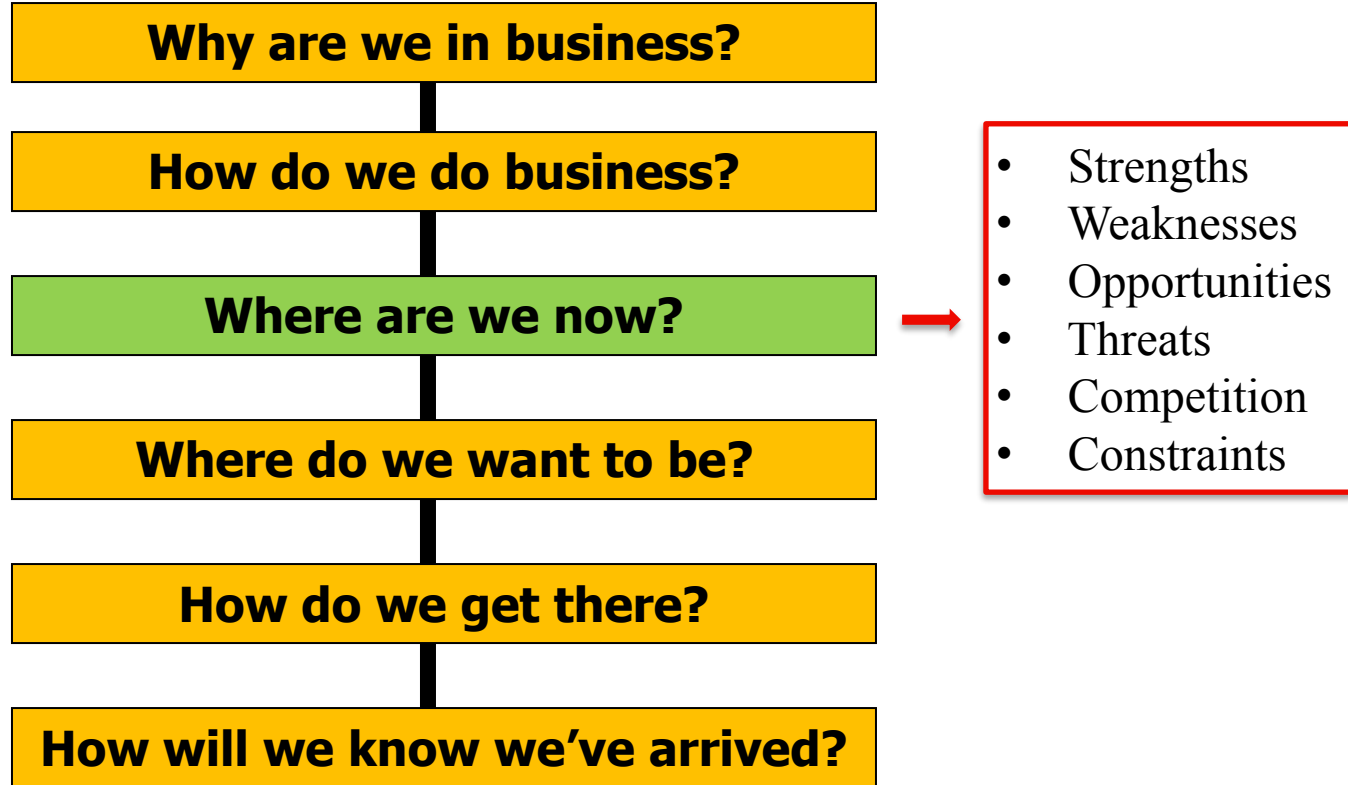
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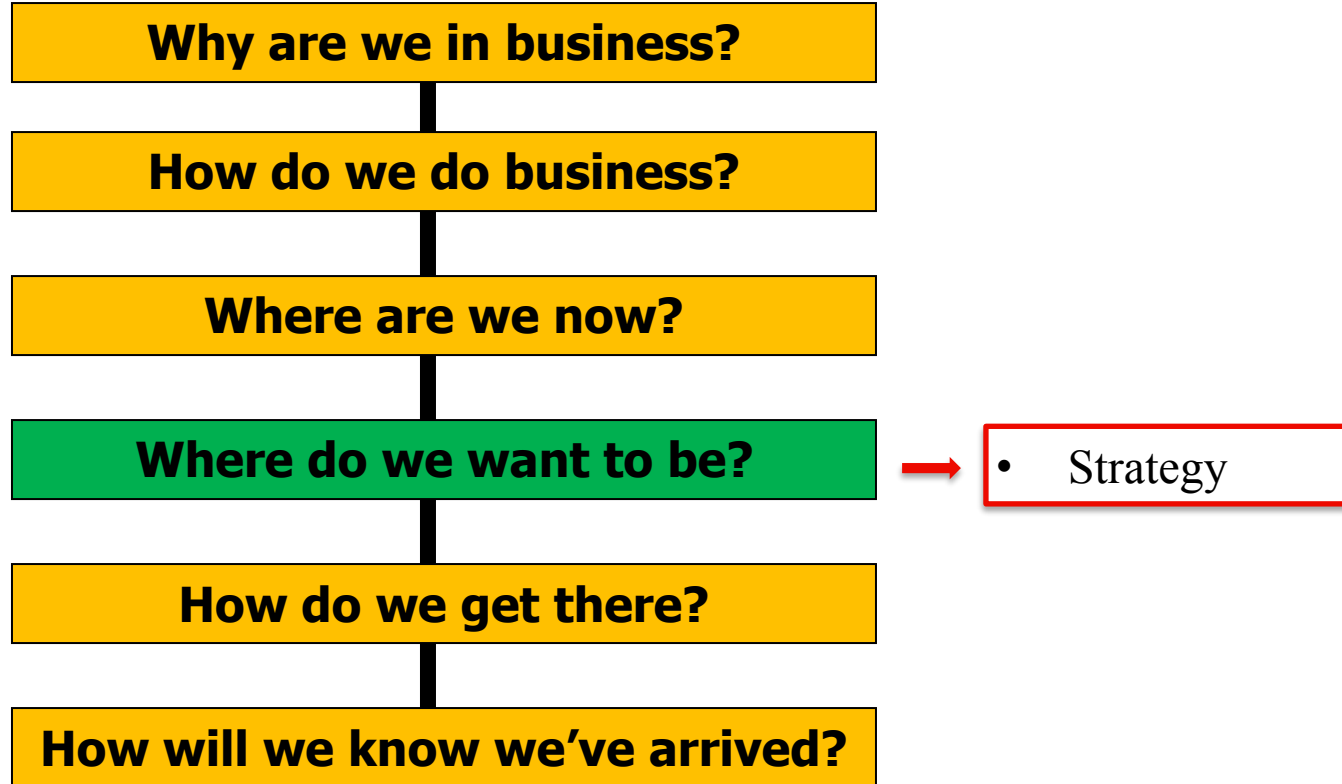
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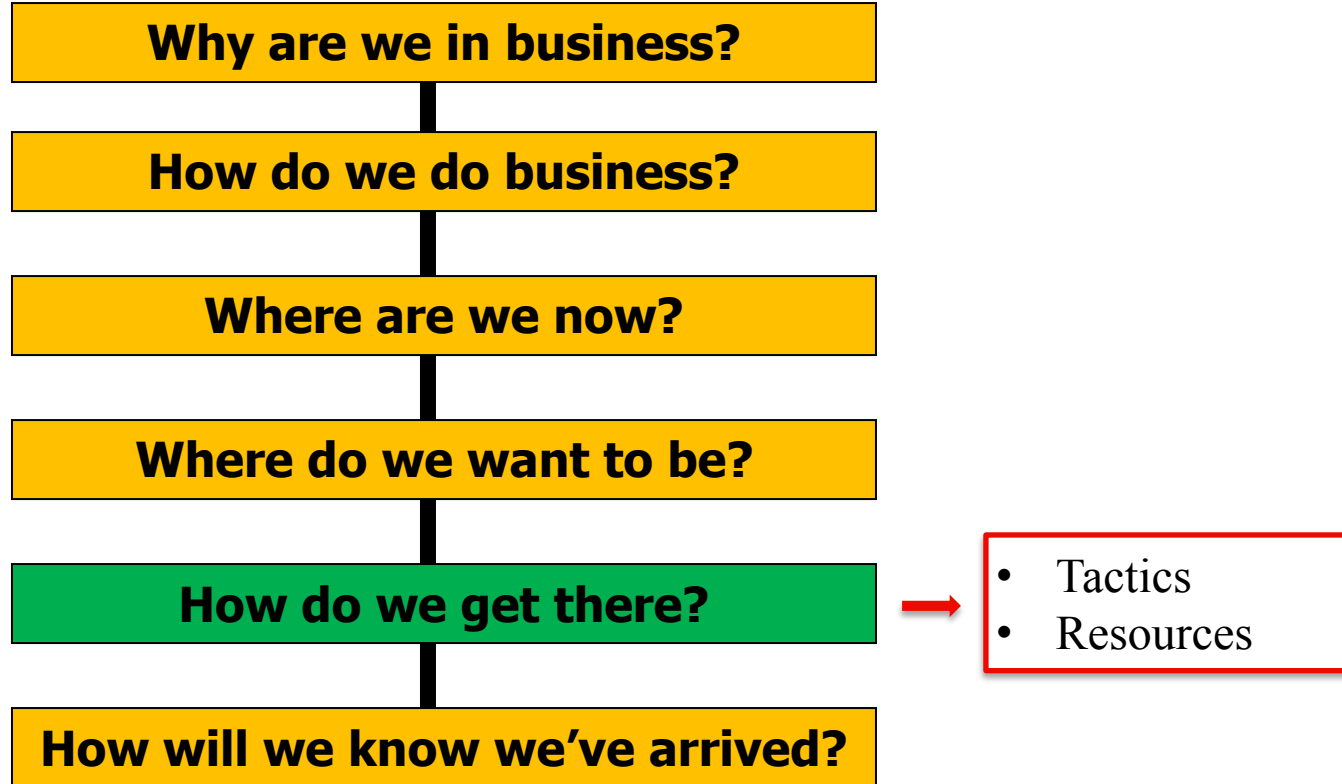
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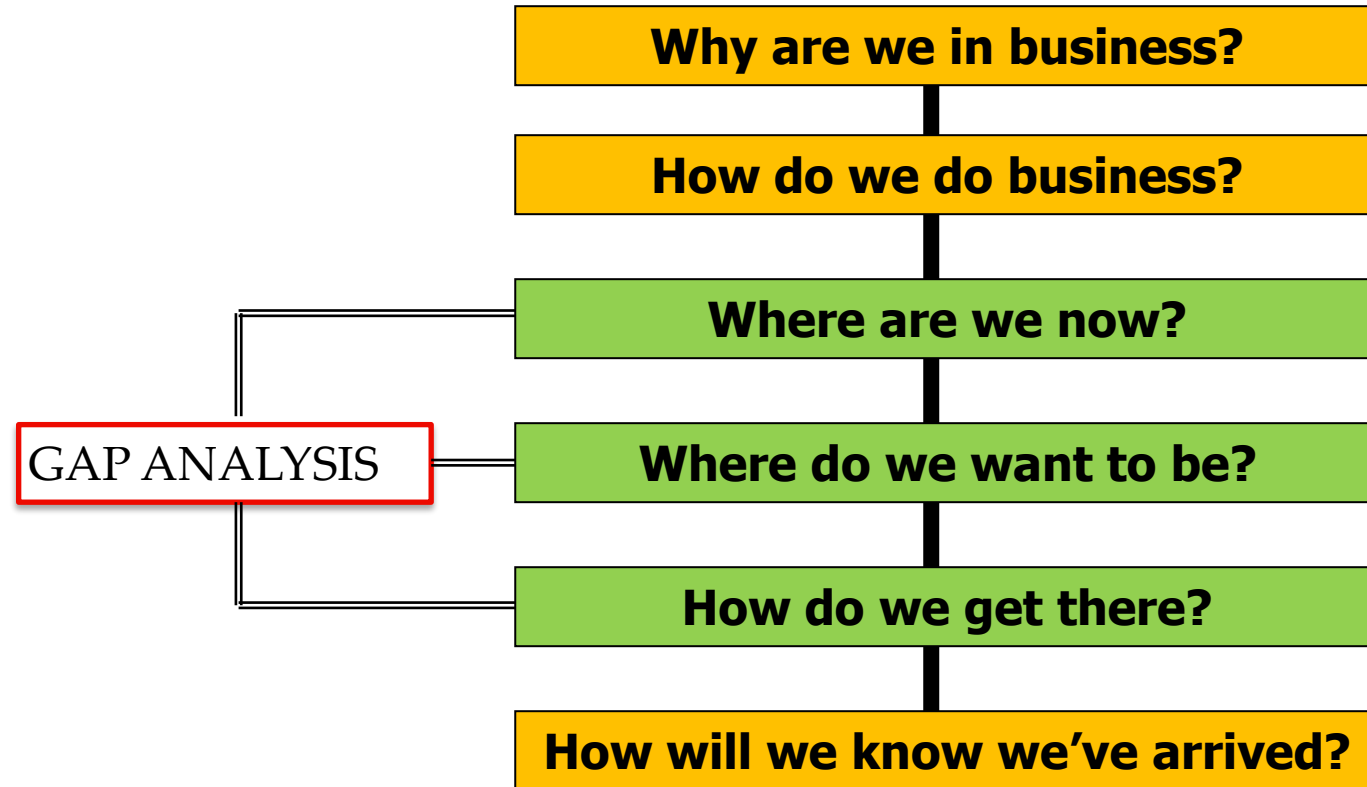
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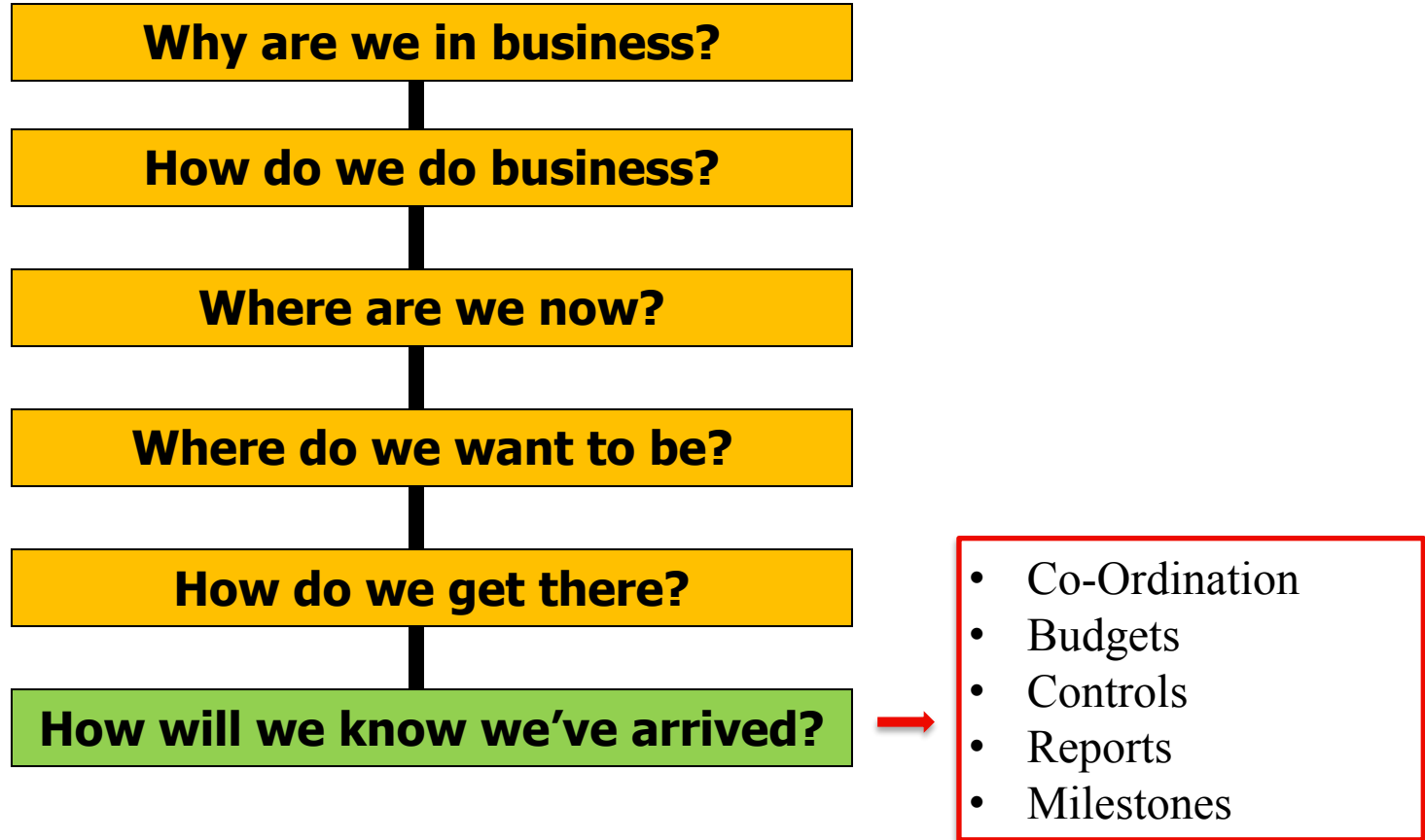
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The "gap" in the gap analysis process refers to the space between "where we are" as a part of the business (the present state) and "where we want to be" (the target state or desired state).

# The Crouch Diagram

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# Strategy in General

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- Strategy, in general, refers to how a given objective will be achieved
  - Hence strategy in general is concerned with the relationships between ends (goals) and means.
  - Strategy and tactics are both concerned with formulating and then carrying out courses of action intended to attain particular objectives
    - Strategy is concerned with deploying the resources at your disposal
    - Tactics is concerned with employing them
  - Together, strategy and tactics bridge the gap between ends and means .

# Strategy in General

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- The table below summarizes some of the more important.

Aspects	Strategy	Tactics
Scale of the Objective	Grand	Limited
Scope of the Action	Broad and General	Narrowly Focused
Guidance Provided	General and Ongoing	Specific and Situational
Degree of Flexibility	Adaptable, but not hastily changed	Fluid, quick to adjust and adapt in minor or major ways
Timing in Relation to Action	Before Action	During Action
Focus of Resource Utilization	Deployment	Employment

# Six Tips For Strategic Planning

# Six Tips for Strategic Planning

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- ① Strategic planning is a way of thinking, an on going process.
  - The plan is never perfect or complete.
- ② Keep the planning simple and manageable.
- ③ Involve the organization's leaders.
  - Don't give away the planning task to support staff or consultants.

# Six Tips for Strategic Planning

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- ④ Emphasize creativity, innovation, and imagination rather than blindly following a set of planning steps.
- ⑤ Don't adopt strategies without careful consideration of how they will be implemented.
- ⑥ Strategic planning is not an end in itself.
  - It is a tool to help the organization accomplish its mission.

# Ten Pitfalls of Strategic Planning

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- ① Planning the future primarily on the basis of statistical and financial projections or forecasts.
- ② Overnighting a thick packet of forms to every branch to complete and return them to the corporate office in 10 business days.

# Ten Pitfalls of Strategic Planning

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- ③ Giving strategic planning lip-service, but not giving time or support necessary to develop or implement a credible plan.
- ④ Rolling out a new company-wide, long-term planning process and leaving incentive packages tied to short-term results unchanged.
- ⑤ Blaming competitors, customers, payers, regulators, or the sales force for the poor strategic performance of the agency or company.

# Ten Pitfalls of Strategic Planning

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- ⑥ Investing in training all line managers in techniques to build an exciting agency future and then downsizing.
- ⑦ Adopting a strategy inherited through the acquisition of a former rival or simply imitating a current competitor.



# Ten Pitfalls of Strategic Planning

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- ⑧ Starting with a vision or mission that fails to capture the imagination and ownership of the grunts in the field.
- ⑨ Letting the bean counters in the business office or in accounting or finance reduce the future to a series of monthly bottom lines.
- ⑩ Trying to step into the future with both feet planted firmly in past because of a myopic view of tomorrow as what we like about today.

# Four Basic Strategies

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<b>Rational-Empirical</b>	<b>People are rational and follow self interest</b> change based on communication of information and offering incentives
<b>Normative-Re-educative</b>	<b>People are social beings and follow social norms</b> change based on redefining and reinterpreting existing norms, & developing commitment to new norms
<b>Power-Coercive</b>	<b>People are mostly compliant, do as they're told</b> change based on the exercise of authority and the imposition of sanctions
<b>Environmental-Adaptive</b>	<b>People oppose loss/disruption but adapt readily</b> change based on building a new organisation and gradually transferring people to the new one

# Factors in Selecting Strategies

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There is no single perfect strategy ... please consider:

- Degree of Resistance
  - Strong: Power-Coercive & Environmental-Adaptive
  - Weak: Rational-Empirical & Normative-Re-educative
- Target Population
  - Large populations need all four strategies in a mix  
‘something for everyone’

# Factors in Selecting Strategies

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- The Stakes
  - High stakes need all four strategies in a mix ‘nothing left to chance’
- The Time Frame
  - Short: Power-Coercive
  - Longer: Rational-Empirical & Environmental-Adaptive & Normative-Re-educative

# Factors in Selecting Strategies

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- Expertise
  - Mix the strategies according to the expertise of the Change Agents
- Dependency
  - If the organisation is dependent on its people, managements ability to lead is limited
  - If people are dependent on the organisation, their ability to resist or oppose is limited
  - Mutual dependency requires negotiation

# Planning Teams

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- The planning design frequently calls for a small team to direct efforts and develop the written document
  - Input should come from the entire organization so that each member has a stake in the process and outcome
- Team members should
  - Work well together
  - Be committed to the process
  - Be respected by their peers

# Planning Teams

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- Team Leader
  - Should understand planning well enough to help others through the process
  - If this is a first-time experience for everyone involved, outside expertise may be useful to provide an initial orientation or a jump start

# Who Should Be Involved in Planning?

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- Establish clear guidelines for membership, for example
  - Those directly involved in planning
  - Those who will provide key information to the process
  - Those who will review the plan document
  - Those who will authorize the document
  - Etc.



# Who Should Be Involved in Planning?

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- The chief executive and board chair should be included in the planning group
  - Should drive development and implementation of the plan

# Who Should Be Involved in Planning?

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- A primary responsibility of a board of directors is strategic planning to effectively lead the organization
  - Therefore, insist that the board be strongly involved in planning
  - Including assigning a planning committee (often, the same as the executive committee)

# Who Should Be Involved in Planning?

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- Always include in the group, at least one person who ultimately has authority to make strategic decisions
- Ensure that as many stakeholders as possible are involved in the planning process

# Who Should Be Involved in Planning?

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- Involve at least those who are responsible for composing and implementing the plan
- Involve someone to administrate the process, including
  - Arranging meetings
  - Helping to record key information
  - Helping with flipcharts
  - Monitoring status of pre-work, etc.

# Who Should Be Involved in Planning?

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- Phases in Team membership
- Strong board involvement in determining the organization's strategic direction
  - Mission
  - Vision
  - Values

# Who Should Be Involved in Planning?

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- Then more staff involvement in determining the organization's strategic analysis to determine its current issues and goals
- Then primarily the staff to determine the strategies needed to address the issues and meet the goals

# Who Should Be Involved in Planning?

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- In general, where there's any doubt about whether a certain someone should be involved in planning, it's best to involve them

# References and Reading

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- ❖ **Chapter 1** - McCabe, J. D. (2010). *Network Analysis, Architecture, and Design*. San Diego, CA, USA: Elsevier Science.
- ❖ **Chapter 1** - Kurose, J. F. (2017). *Computer networking : a top-down approach* (Seventh, global edition. ed.). Boston: Pearson.
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Thank you  
Q&A ?

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