Chapter 3 *The Network Development Life Cycle*

Topics covered:
Network analysis. Network design methodology. Writing of a Request For Proposal (RFP) and quotation analysis. Prototyping/simulation. Implementation.

3.1 Introduction

The Network Development Life Cycle (NDLC) depends upon previously completed development processes such as strategic business planning, application development life cycle, etc.

To fulfill strategic business goals, a top-down approach must be taken to the overall information systems development process. (Ref.1. Figure 12.1)

3.2 Information Systems Development: Process & product

- **Process:** used to visualize what should be done at any point of the development cycle.
- **Product:** milestone or deliverable indicating completion of one stage of the development cycle.

There is a need for significant analysis and design, and associated products or deliverables, prior to the commencement of any network analysis and design activities. (Ref.1. Figure 12.2)

3.3 The Network Development Life Cycle

The NDLC is of an ongoing nature. The network design must be dynamic to support any changing requirements.

3.4 Network Analysis and Design Methodology

A network analysis and design methodology is a practical, step-by-step approach to network analysis and design.

3.4.1 Overall Characteristics

- Requirements (business, application, and data) definition is required prior to network design activities.

- Expected compliance with requirements in a Request For Proposal (RFP) by both in-house personnel and outside consultants.

- Activities from various stages often take place simultaneously and backtrack to previous activities is sometimes needed.

- This methodology is an overall guideline to the network development process rather than "cookbook" instructions.

3.4.2 Critical success factors of the NDLC

These factors are best seen as habits or behaviors, rather than discrete events to be scheduled or planned. They include:

- Identification of all potential customers and constituencies:
    - All groups must be consulted.

- Political awareness:
    - Corporate culture: hierarchical, distributed, or open.
    - Backroom politics can play a role in systems design.
    - Find ways to ensure objectivity of the analysis and design process (e.g., measurable goals).

- Buy-in:
    - Reach consensus on the acceptability of results of each stage.
    - Approved results of one stage become the foundation or starting point for the next stage.
    - Makes the final presentation smoother.

- Communication:
    - With all groups.
    - Write memos, communicate with key people in person, etc.

- Detailed project documentation:
    - Prepare agendas
    - Take meeting minutes
    - Action items
    - Use a project binder for all the above

- Process/Product awareness:
    - Stay focused: what is the process/product at each stage?
    - Keep meeting on track: no off-subject discussions.

- Be honest with yourself:
    - Be your own harshest critic (no one else knows the potential weaknesses or areas for improvement in your proposal better than you.
    - Use peer reviews.
    - Not all weaknesses can be corrected (e.g., financial or time constraints).

3.4.3 Overall Guidelines

- Start with a clearly defined problem:
    - Identify affected parties and representatives.
    - Held brainstorming sessions to define problems and requirements of a solution.

- Understand strategic business objectives defined by senior management.

- Collect baseline data from customer groups about the current status of the system and network. This is used to measure eventual impact of the installed network.

- Feasibility studies and buy-in:
    - Feasibility study: problem definition and associated alternatives recommendations for further study.

3.5 Strategic Information System Design

The primary mission of a network is the delivery of the right information at the right time to the right decision-maker in the right place. All these components are determined by the strategic information system design (SISD).

- The SISD process starts with review of strategic business goals articulated by senior management.

- Then, SISD describes the overall characteristics of an information system that fulfills these goals.

- The evaluation criteria associated with these goals is a key product of SISD and must be objective and measurable. This assures the objectivity of the entire network analysis and design phase.

- The importance of these criteria lies in their ability to measure the extent to which the information system designs deliver strategic business goals.

- Identify opportunities for improvement of business processes in areas such as: financial, customer satisfaction, employee retention, etc. Then, identify information required to turn opportunities into reality.

    - If it isn't broken, don't fix it
    - Must have measured how bad the old process was
    - Learn from other's mistakes (related industries with failures)
    - Don't be afraid to admit mistakes (admit them early and make corrections ASAP to minimize the impact)

- Develop specific evaluation criteria: from these opportunities and the information required to turn them into reality

- Prioritization - three pile approach:
    - Priority 1 items: must be implemented
    - Priority 2 items: need to be implemented ASAP (i.e., "work-around" temporarily)
    - Priority 3 items: nice to have (but can live without them)

- Producing the Request For Proposal (RFP):
    - By organizing all the information gathered.
    - All vendors' proposals are measured against RFP requirements.
    - Examine each corporate location: location survey of data and processing requirements.
    - Final RFP preparation. The RFP should include:
        - SISD
        - Corporate location survey results
        - Management abstract:
            - Company profile: number of locations, growth rate, etc.
            - Statement of the problem.
            - Overall system characteristics: vendors can check first if they have the required capabilities to meet requirements.
            - Project phase prioritization: some modules are more critical than others.
            - Proposed project schedule summary.
            - Information requested from vendors.
                - To avoid standard proposals
                - To ensure:
                    - Vendor has significant experience
                    - Vendor has large organization
                    - Vendor is financially solvent

- Percent-to-fit goal:
    - Arbitrary percentage determined by user groups
    - Sets minimum threshold of compliance for vendor proposals to warrant further consideration and invitations for demonstrations (e.g., 50% of priority 1 features are met). This applies to in-house development as well.
    - Objective "score": counting how many features of each priority are present in a proposal.

- Proposal evaluation and the make or buy decision:
    - Invite selected vendors for demonstrations (e.g., Proof of Concept (POC))
    - Buy-in on selected vendors and vendor selection process.
    - Check every feature included in vendor's proposal at the demonstration.
    - Make or buy decision.

- Outsourcing:
    - Hire outside contractors to operate and maintain corporate information systems and networks.

3.6 In-house Network Analysis and Design

A network must be designed to deliver solutions and performance in response to specific, well defined, data, application, and business layer requirements.

- Data traffic analysis:

    - Payload type analysis: e.g., video, voice, and data.

    - Transaction analysis:

        - Examine the source of data, e.g., order entry, pricing lookup
        - Amount of data required to complete each transaction is calculated and documented

        → This influences which type of network to use, e.g., high speed

- Time studies: Analyze when and how these transactions are executed, i.e., counting how often and what time of the day, week, etc. a transaction is executed.
  → This influences bandwidth requirements.

- Traffic volume analysis: Construct a time sensitive traffic volume requirements profile (from transaction analysis and time studies), i.e., average, minimum, maximum bandwidth requirement

- Mission critical analysis: e.g., Electronics funds transfer
  - Requirements: data security, encryption of data transmitted
  - Redundant links may be needed

- Protocol stack analysis: will the network support more than one protocol? What are the bandwidth and network hardware implications?

- Network configuration alternatives (Logical design):

  - Local carriers may be limited in their offering of certain data transmission services → limitation on your design.

  - Capacity: ensure sufficient bandwidth is allocated to handle sudden increase in demand.

  - Reliability: sufficient redundancy is implemented

  - Security

  - Cost (for senior management to decide)

- Network hardware analysis and configuration alternatives (Physical design):

  - Depends on the results of the two previous analysis reports. If these are valid, then networking devices chosen to tie the network together should be valid as well.

- Prepare a comprehensive budget

  - Prevent surprises: required or anticipated facilities upgrade are identified during survey (in RFP preparation)

  - Three cost categories: Acquisition, Operations, and Anticipated growth

- Prepare the final proposal, i.e., RFP response or network design document

3.7 Contents of a Network Design Document

1. Executive Summary: targeted at the managers and key project participants

2. Project Goal: should be business-oriented

3. Project Scope: information on the extend of the project

4. Design Requirements

4.1. Business Goals: how the network will help in providing better products and services.

4.2. Technical goals: Scalability, Availability, Performance, Security, Manageability, Usability, Adaptability, Affordability.

4.3. User Communities and Data Stores: user communities, locations, applications, and data stores (servers and hosts).

4.4. Network Applications: new and existing ones.

5. Current State of the Network: structure and performance of existing network applications

6. Logical Design:

- Network topology
- Addressing and naming models
- Protocols selected for routing, bridging, and switching
- Recommended security mechanisms and products
- Recommended network management architectures, processes, and products

7. Physical Design:

- Features and recommended uses for the technologies and devices selected.
- Pricing for network devices and services.
- Availability of products.

8. Results of Network Design Testing: from prototype or pilot systems implemented

9. Implementation Plan: for installations, outsourcing, informing users, training, measuring design effectiveness, and fallback and future plans

9.1. Project Schedule: at least dates and deliverables for major milestones

10. Project Budget: funds available for purchases, maintenance, support, licenses, training, and staffing

10.1. Return on Investment: how quickly the design will pay for itself

11. Design Document Appendix

3.8 The Network Implementation Process

- Pilot tests: to safely roll out new systems or networks. E.g., deploy/implement the new system on one site, monitor performance, fix problems, and gain experience before deployment on a wider scale.

- Project management:

    - Detailed task lists

    - Manual or using project management software.

- People are important: buy-in at every stage by all affected parties. ***The best designed network will fail miserably without the support of people.***

3.9 Automating the NDLC

- CANE: Computer-Assisted Network Engineering (CANE): Analysis and design software used to model a current network.

- Simulation tools: performance engineering software tools: overall network performance modeled is a result of the effect of a series of mathematical formulas.

    - Ability to predict performance of various networking scenarios (i.e., what-if analysis).
    - Benefits: spot network bottlenecks, test new applications and network configurations before deployment, re-create circumstances, and replicate traffic volume and transaction types.

- Network management tools.

3.10 References

1. "Applied Data Communications - A Business-Oriented Approach" by James E. Goldman, 1998

2. "Top-Down Network Design" by Priscilla Oppenheimer, Cisco Press, 2001