# Program Information

## Lesson:

### *Employability Skills: Systems Thinking*

## Training:

## Fiber Optic

## Time frame:

### 60 minutes

# Instruction Section

## Learning Objectives:

# Apply systems thinking to troubleshoot fiber optic network issues.

# Apply systems thinking principles to plan cabling projects, considering trickle-down effects.

# Demonstrate improved implementation techniques by considering system interdependencies.

## Assessment Tools/Methods:

# Assess understanding through active participation in class discussions and responses to targeted questions during the lesson.

# Evaluate the effectiveness of the group mapping exercise by examining the accuracy and thoroughness of the cabling system maps and the quality of group discussions.

## Learner Prior Knowledge:

# Basic Understanding of Fiber Optic Technology: Knowledge of fiber optic components, such as cables, connectors, splices, and transmission equipment. Familiarity with common fiber optic terms like attenuation, signal loss, and bandwidth.

# Experience with Fiber Optic Installations: Awareness of standard installation practices, including cable routing, termination, and splicing. Understanding of industry standards and safety protocols.

# Troubleshooting Basics: Ability to identify common fiber optic issues (e.g., poor splicing, damaged cables). Familiarity with basic troubleshooting tools (e.g., OTDR, light source, and power meter).

# Project Planning Concepts: Exposure to planning processes in fiber optic projects (e.g., site visits, route planning, component selection). Awareness of the importance of scalability and cost-effectiveness in design.

# Teamwork and Communication: Experience working collaboratively on fiber optic projects or installations. Basic understanding of how to convey information effectively during technical discussions.

## Instructional Activities:

# Begin by f amiliarizing participants with the concept of systems thinking.

# Ask participants to define systems thinking. (A holistic approach to analyzing how different parts of a system interact and influence each other.)

# Emphasize its importance in fiber optic projects where multiple variables (e.g., equipment, cables, environment) interact.

# Activity 1: Applying Systems Thinking to Troubleshooting

# Highlight interconnected components in fiber optic systems (e.g., connectors, splices, transmission equipment).

# Discuss common problems: high attenuation, misalignment, equipment failure.

# Present the group with the following scenario:

# Scenario: A client reports intermittent signal loss in a newly installed network. Initial testing reveals weak signals on one link.

# The cable route passes near electrical wiring.

# Connectors show signs of improper polishing.

# Equipment logs indicate occasional power fluctuations.

# Discuss the following questions with the group:

# What factors might be causing the issue? (Sample answer: Proximity to electrical wiring (interference), connector issues (signal loss), power fluctuations.)

# How could these factors interact to create the problem? (Sample answer: Electrical interference exacerbates connector issues; unstable power impacts signal strength and equipment reliability.)

# Activity 2: Systems Thinking in Project Planning

# Highlight how decisions in one part of the project (e.g., cable selection) can have a ripple effect on other aspects (e.g., installation complexity, future scalability).

# Example: Choosing cables with insufficient capacity for anticipated network growth can lead to costly upgrades later

# Discuss the importance of accounting for the installation environment, such as using outdoor-rated cables in harsh conditions or avoiding areas with potential interference (e.g., near electrical wiring or HVAC ducts).

# Explain how these constraints influence both material selection and route planning.

# Stress the need to plan for future expansions, such as additional devices or increased bandwidth demands.

# Example: Installing extra conduits or reserving unused fibers in the initial installation phase.

# Introduce strategies for mitigating risks, such as conducting thorough site surveys to identify potential challenges and using redundancy in critical network paths to minimize downtime.

# Encourage involving all stakeholders early in the planning process (e.g., clients, engineers, contractors) to identify potential issues and align expectations.

# Discuss breaking the planning process into manageable steps.

# Assess requirements (client needs, network goals).

# Identify constraints (budget, environment, building structure).

# Create a detailed plan with contingencies.

# Break the participants into small groups and present the following scenario:

# Scenario: You will be planning a fiber optic network for a multi-floor office building. Consider the following:

# Equipment placement (e.g., server rooms, patch panels).

# Cable pathways (e.g., vertical vs. horizontal runs).

# Future scalability (e.g., adding devices or users).

# Allow participants time to complete the Project Planning Guide Handout in their groups.

# Circulate through the groups highlighting solutions if assistance is needed, such as choosing riser-rated cables for vertical runs, reserving spare capacity for scalability, and planning pathways to minimize physical damage risks.

# When the groups are finished, wrap up the activity with a short discussion comparing solutions between the groups.

# Activity 3: Putting Systems Thinking into Practice

# Discuss examples where poor implementation led to failures (e.g., insufficient slack, misaligned splices).

# Emphasize teamwork and communication for smooth implementation.

# Present the final scenario of the lesson to the group:

# Scenario: During an installation, a team discovers that their pre-planned cable route intersects with HVAC ducts, causing delays.

# Have a group discussion covering the following questions:

# What could have been done differently to prevent the issue? (Sample answers: Conduct thorough site visits; consult building schematics.)

* 1. How should the team resolve the issue now? (Sample answer:Re-route cables while maintaining slack requirements and adhering to standards.)

# Ask participants to discuss situations where they have experienced issues on the job where poor implementation led to failure down the road.

# Activity 4: Troubleshooting with Systems Thinking and Wrap-up

# Begin concluding the lesson by asking the group to explain, “What is systems thinking?” (Ex: A holistic approach to analyzing interdependencies within a system. In a fiber optic network, how cable choice affects attenuation, splicing, and future scalability.)

# Remind participants of the importance of identifying root causes in troubleshooting issues by considering all contributing factors.

# Discuss why understanding the trickle-down effect on system-wide impacts is important to understand and consider on the job.

# Ask participants to discuss why implementing a system thinking mindset is important for technicians.

# Sample answer: Systems thinking reduces costs, improves reliability, and ensures the long-term success of fiber optic projects.

# After reviewing the material covered in the lesson, open the floor for any questions from participants.

##  Resources:

# Whiteboard and markers

# Project Planning Guide Handout

*Note: AI, specifically ChatGPT 3.5, was used to generate scenarios for this contextualized lesson plan*

# Reflection Section

How can understanding the interconnections between system components improve your approach to troubleshooting, planning, or implementing fiber optic projects? Provide an example from the lesson or your experience. What challenges do you foresee in applying systems thinking to real-world projects, and how might you address those challenges?

**Project Planning Guide Handout**

**Instructions**

Use this guide to map out the key aspects of your fiber optic project. Fill out each section with your group’s decisions and considerations. Be prepared to discuss your rationale and how systems thinking influenced your choices.

**Section 1: Project Overview**

1. **Project Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. **Objective:**
What is the goal of this project? (e.g., connect multiple floors, expand bandwidth, upgrade infrastructure) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Scope:**
Describe the size and complexity of the network.
	* Number of connections: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Area covered: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Estimated data demand: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Section 2: Key Considerations**

1. **Environmental Factors**
Identify any challenges in the physical or environmental setting.
	* Outdoor vs. indoor? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Environmental hazards (e.g., temperature, water, interference): \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Cable Types**
What type of cables will you use?
	* Fiber type (Singlemode/Multimode): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Special requirements (e.g., riser-rated, armored): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. **Equipment Placement**
Determine locations for key equipment (e.g., patch panels, routers, switches).
	* Location(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Why did you choose these spots? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Section 3: Dependencies**

1. **Component Relationships**
How do your choices for cables, connectors, and equipment affect each other?
	* Example: “We chose armored cables to withstand harsh conditions, which required compatible connectors.”

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1. **Installation Constraints**
Identify any installation challenges that might arise from your decisions.

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**Section 4: Future-Proofing**

1. **Scalability**
How have you planned for network growth?
	* Extra fibers/conduits: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	* Planned upgrade paths: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Long-Term Risks**
What risks do you foresee, and how will you address them?

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**Section 5: Final Plan**

1. **Proposed Route:**
Sketch or describe your cable route below (consider pathways, conduits, and obstacles):

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1. **Budget Considerations:**
Estimate costs for major components.
	* Cables: $\_\_\_\_\_\_\_\_\_\_
	* Connectors: $\_\_\_\_\_\_\_\_\_\_
	* Equipment: $\_\_\_\_\_\_\_\_\_\_
	* Labor: $\_\_\_\_\_\_\_\_\_\_
2. **Team Assignments:**
List team roles for key tasks (e.g., installation, testing).

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