Artificial Intelligence-Enabled Cyber Training

An Approach to Accelerated Training Development

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3rd Multi Domain Task Force, U.S. Army Pacific

The overall classification of this brief is: **UNCLASSIFIED**

Version: **9.0**

Disclaimer: The views expressed here are those of the author and do not necessarily reflect the official position of the Department of the Army or Department of Defense.

Agenda & Purpose

Agenda

- Title Slide
- **Agenda & Purpose**
- Cyber Training and Certification Pipeline
- Manual to AI-Enabled to AI-Driven Training Development
- Accelerated Training Development Process
- AI- Versus Human-Generated Training Material
- Questions, Comments, & Closing

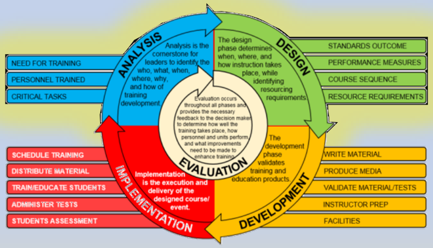
Purpose

The purpose of today's brief is to explain how artificial intelligence (AI) has accelerated the development of defensive cyber analyst training. I'll briefly frame the problem, then delve into the process, key inputs and outputs at each stage, and close with a look at the final products of this initiative.

Cyber Training and Certification Pipeline

LEGEND
- 🟩 Resourced / Completed
- 🟨 Resourcing / In Progress
- ⬜ Not Available / Not Started

"The Army learning Concept for 2030- 2040 focuses on individual, tailored, and **career-long** learning integrated seamlessly along a learning continuum with **unit training systems and processes** to support the conduct of **multidomain operations.**" – TRADOC Pamphlet 525-8-2


ANALYSIS
Analysis is the cornerstone for leaders to identify the who, what, when, where, why, and how of training development.
NEED FOR TRAINING
PERSONNEL TRAINED
CRITICAL TASKS
DESIGN
The design phase determines when, where, and how instruction takes place, while identifying resourcing requirements.
STANDARDS OUTCOME
PERFORMANCE MEASURES
COURSE SEQUENCE
RESOURCE REQUIREMENTS
EVALUATION
Evaluation occurs throughout all phases and provides the necessary feedback to the decision maker to determine how well the training takes place, how personnel and units perform, and what improvements need to be made to enhance training.
DEVELOPMENT
The development phase validates training and education products.
WRITE MATERIAL
PRODUCE MEDIA
VALIDATE MATERIAL/TESTS
INSTRUCTOR PREP
FACILITIES
IMPLEMENTATION
Implementation is the execution and delivery of the designed course/ event.
SCHEDULE TRAINING
DISTRIBUTE MATERIAL
TRAIN/EDUCATE STUDENTS
ADMINISTER TESTS
STUDENTS ASSESSMENT

Proficiency

Master: Supervise training

Senior: Operate without supervision

Basic: Operate with supervision

Industry Training

- ???
- ???
- SANS FOR 610
- SANS SEC 599
- SANS SEC 595
- SANS SEC 555
- SANS FOR 572
- SANS FOR 508
- SANS FOR 578
- AND CyberChef for Analysts
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- AIT

Unit-Internal Training

M

- Endpoint enumeration
- Basic malware analysis
- Metrics
- Forensic host analysis
- Advanced report writing
- Host forensic platform
- Network attack path enumeration
- Privilege escalation path enumeration
- Cyber attribution

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- Indicator-based analysis
- Advanced security concepts
- Exploratory data analysis
- Advanced network analysis
- Advanced network attack techniques
- Advanced host forensic collection
- Advanced host analysis
- Detection evasion and counter evasion
- Report writing
- Advanced host attack techniques
- Cueing
- Enterprise info sys mgmt
- Information collection matrices
- Active Directory
- Tactic, technique, and procedure-based analysis

B

- Basic security concepts
- Basic host forensic collection
- Common protocols and ports
- Intrusion detection and prevention systems
- The RFI process
- Routing
- Introduction to the CMF
- Basic host forensic collection
- Sources for cyber threat intel
- Basic host analysis
- Basic network attack techniques
- Unix operating systems
- Network composition and topology
- Basic host attack techniques
- Cyber risk
- Capturing, storing, and viewing network data
- Capturing, viewing, and storing host data
- Basic analysis techniques
- DCO Mission Planning
- Windows operating systems
- Scripting
- Incident handling
- Structured analytic techniques
- Basic Network Analysis
- Cyber threat frameworks
- Information systems mgmt
- The analysis process
- The intelligence cycle

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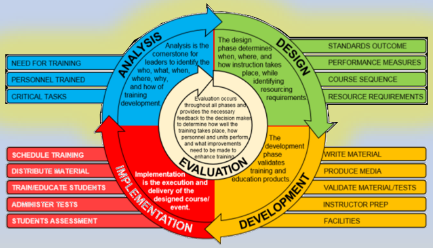
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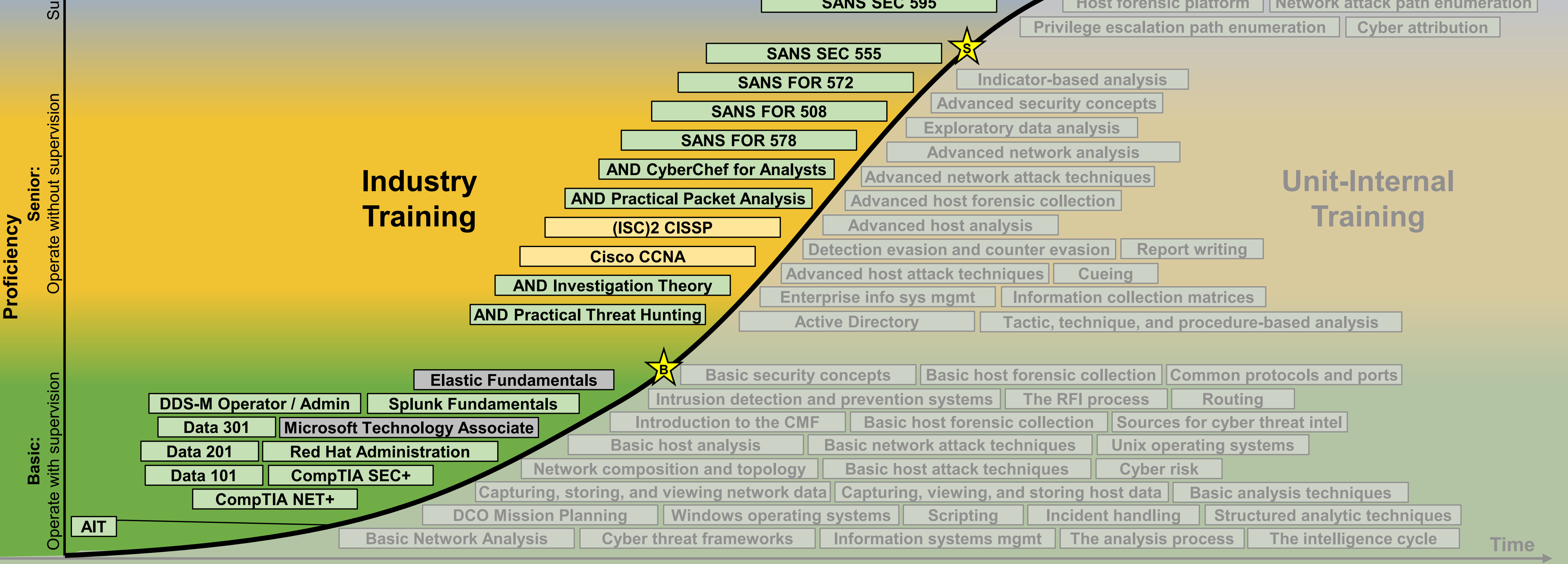
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Unit-Internal Training

Industry Training:

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- Cyber threat frameworks
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- Host forensic platform
- Network attack path enumeration
- Forensic host analysis
- Advanced report writing
- Basic malware analysis
- Metrics
- Endpoint enumeration

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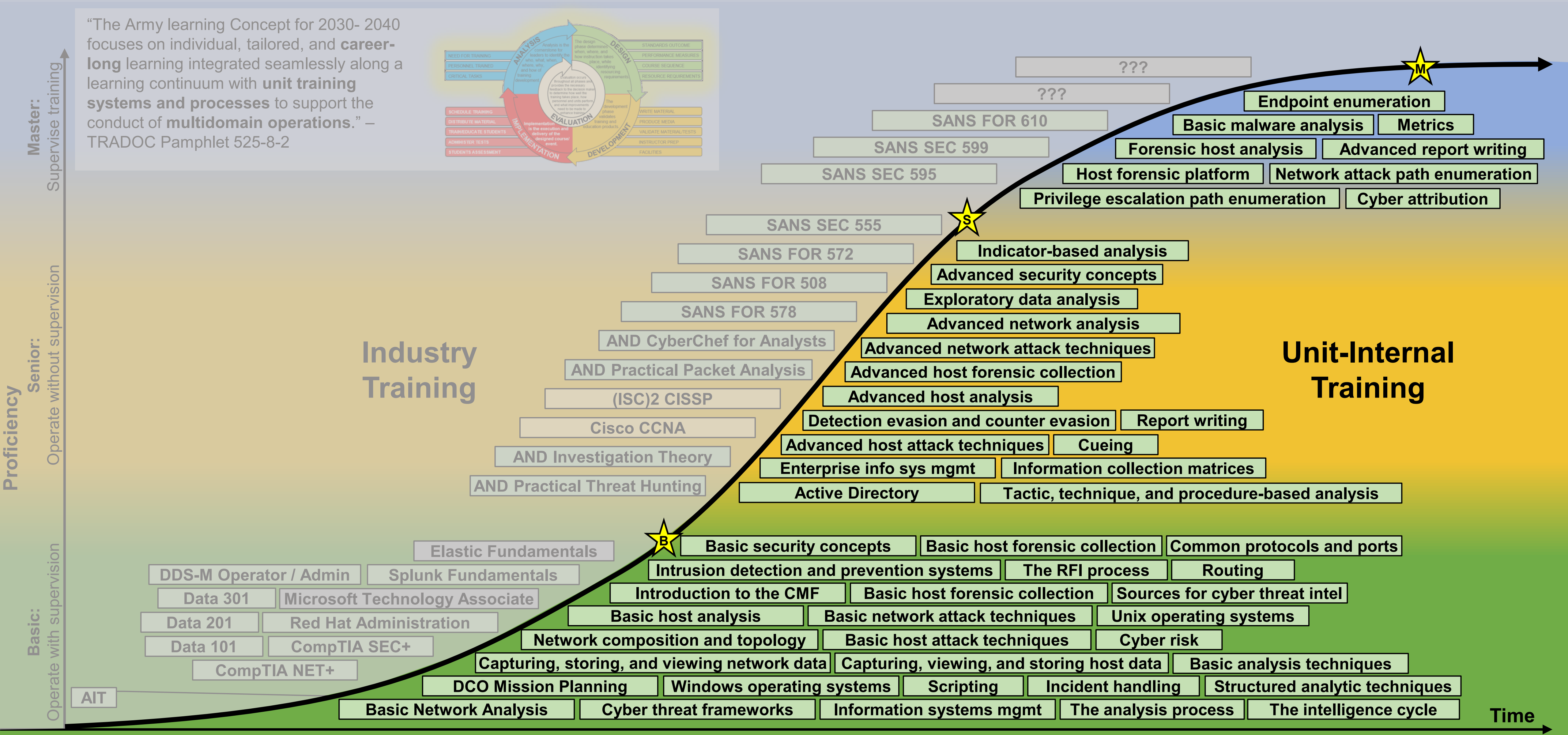

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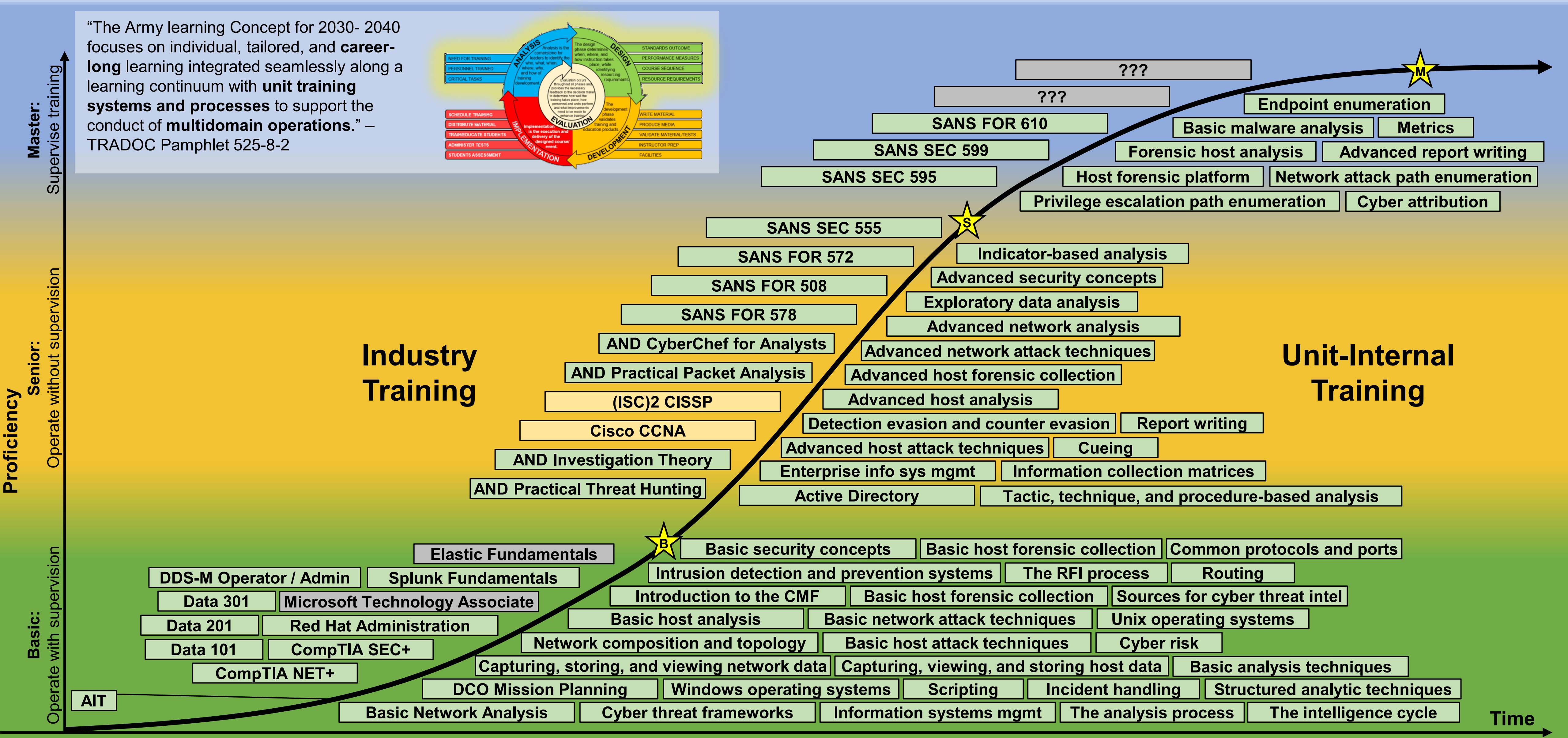
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Manual to AI-Enabled to AI-Driven Training Development

Manual

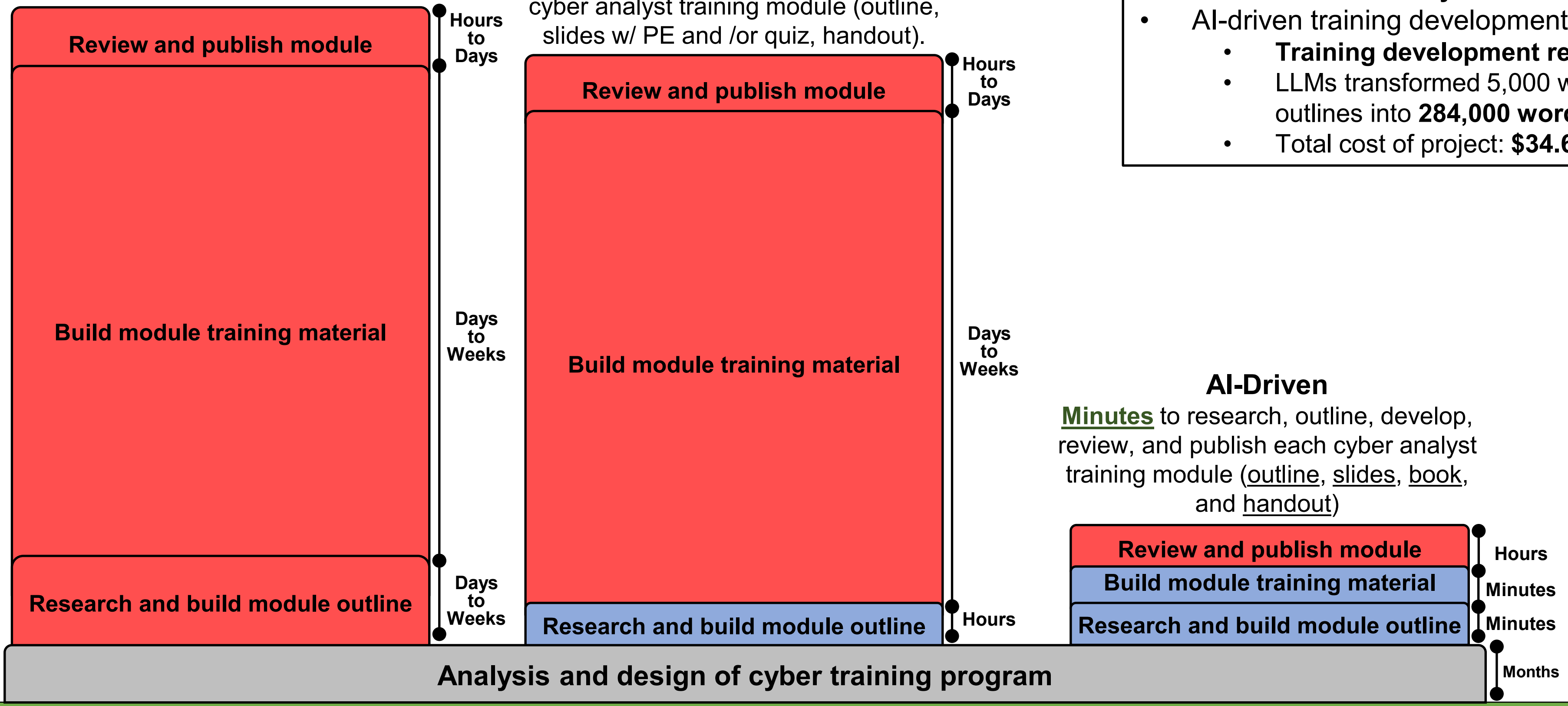
1 to 2 months to research, outline, develop, review, and publish each cyber analyst training module (outline, slides w/ PE and /or quiz, handout)

AI-Enabled

1 to 2 months to research, outline, develop, review, and publish each cyber analyst training module (outline, slides w/ PE and /or quiz, handout).

AI-Driven

Minutes to research, outline, develop, review, and publish each cyber analyst training module (outline, slides, book, and handout)



Review and publish module | Hours to Days

Build module training material | Days to Weeks

Research and build module outline | Days to Weeks

Review and publish module | Hours to Days

Build module training material | Days to Weeks

Research and build module outline | Hours

Review and publish module | Hours

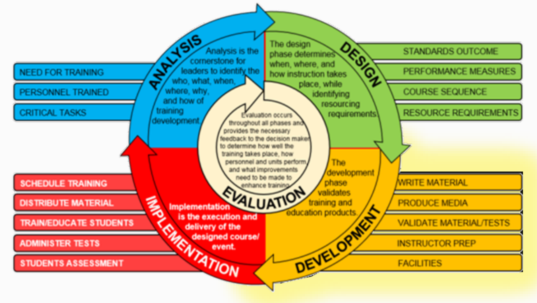
Build module training material | Minutes

Research and build module outline | Minutes

Analysis and design of cyber training program | Months

Key Data Points & Results

- Started with ~5,000 words in module descriptions (prompts).
- Manual training development:
  - 1 to 2 months to research, outline, develop, review, and publish **each** cyber analyst training module.
  - **Estimated ~1 year to develop entire unit-internal training pipeline.**
- AI-enabled training development:
  - **Optimizing for the wrong constraint** led to similar 1 to 2 months to research, outline, develop, review, and publish **each** cyber analyst training module.
  - **Estimated ~1 year to develop entire unit-internal training pipeline.**
- AI-driven training development:
  - **Training development reduced to minutes.**
  - LLMs transformed 5,000 word module descriptions into 60,000 words of outlines into **284,000 words on 1,600** slides of course material.
  - Total cost of project: **$34.68**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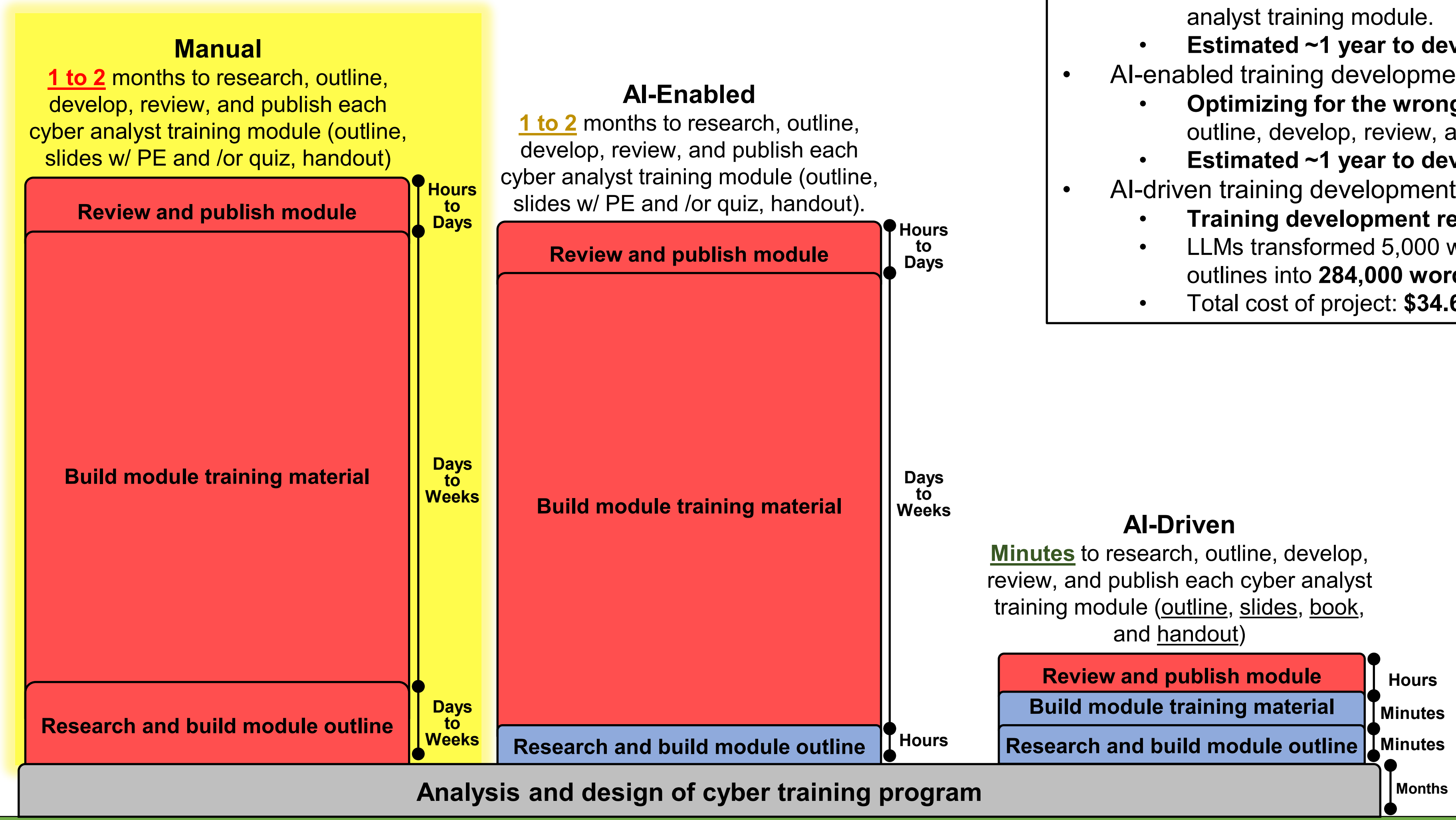
"Future Army forces require the capability to **rapidly understand, develop, and implement** training and education changes in order to meet shifting operational demands in the MDO environment. (paras 3-6.b and 3-8.b.)" – TRADOC Pamphlet 525-8-2

Manual to AI-Enabled to AI-Driven Training Development



Manual

1 to 2 months to research, outline, develop, review, and publish each cyber analyst training module (outline, slides w/ PE and /or quiz, handout)

Review and publish module
Hours to Days
Build module training material
Days to Weeks
Research and build module outline
Days to Weeks

AI-Enabled

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AI-Driven

Minutes to research, outline, develop, review, and publish each cyber analyst training module (outline, slides, book, and handout)

Review and publish module
Hours
Build module training material
Minutes
Research and build module outline
Minutes
Analysis and design of cyber training program
Months

Key Data Points & Results

- Started with ~5,000 words in module descriptions (prompts).
- Manual training development:
  - 1 to 2 months to research, outline, develop, review, and publish **each** cyber analyst training module.
  - **Estimated ~1 year to develop entire unit-internal training pipeline.**
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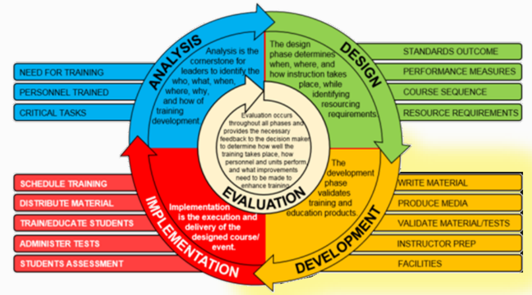

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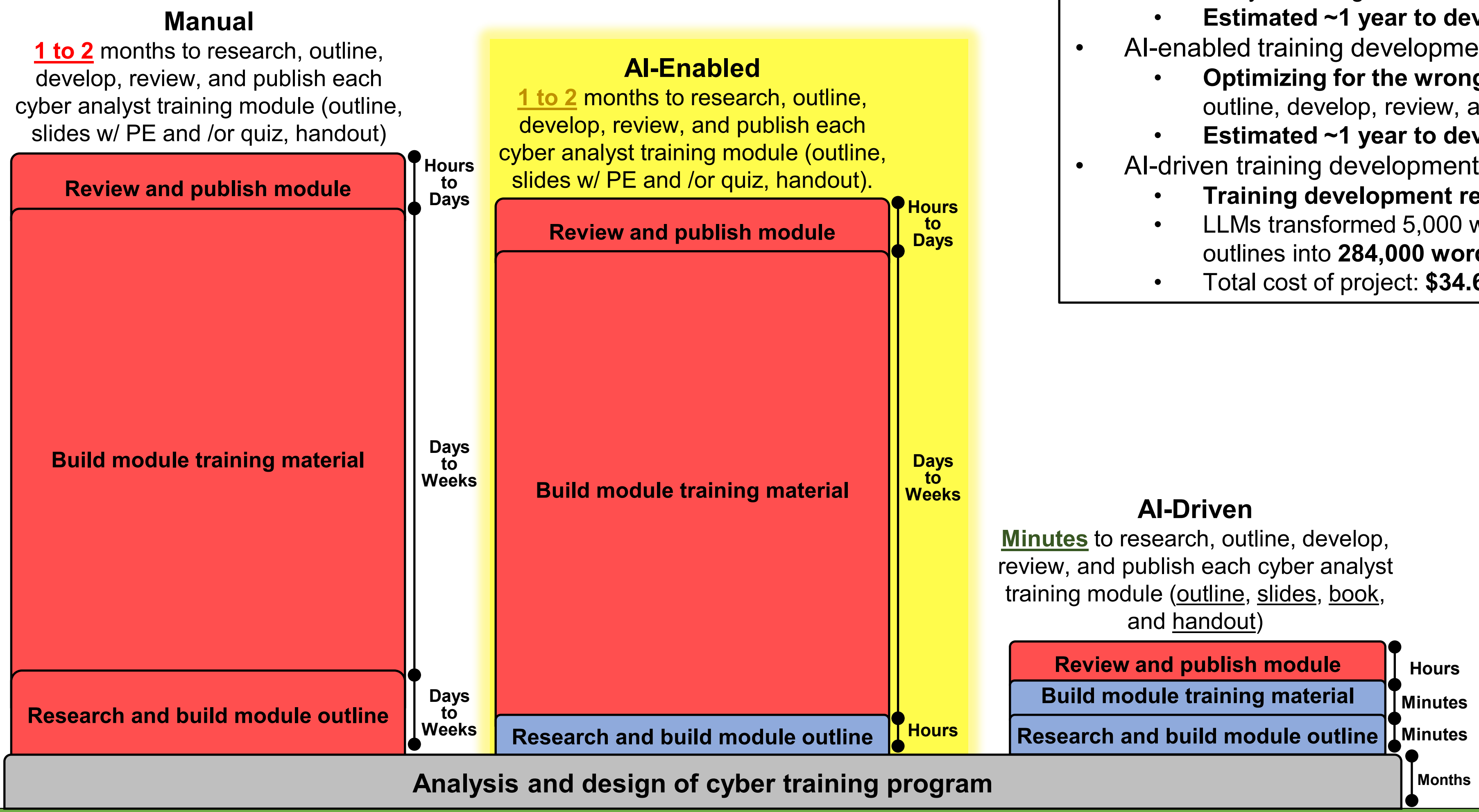

Manual

1 to 2 months to research, outline, develop, review, and publish each cyber analyst training module (outline, slides w/ PE and /or quiz, handout)

Review and publish module — Hours to Days

Build module training material — Days to Weeks

Research and build module outline — Days to Weeks

AI-Enabled

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AI-Driven

Minutes to research, outline, develop, review, and publish each cyber analyst training module (outline, slides, book, and handout)

Review and publish module — Hours

Build module training material — Minutes

Research and build module outline — Minutes

Analysis and design of cyber training program — Months

Key Data Points & Results

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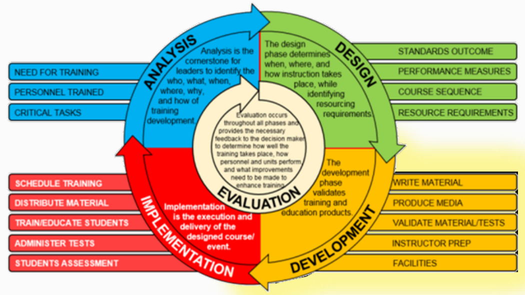
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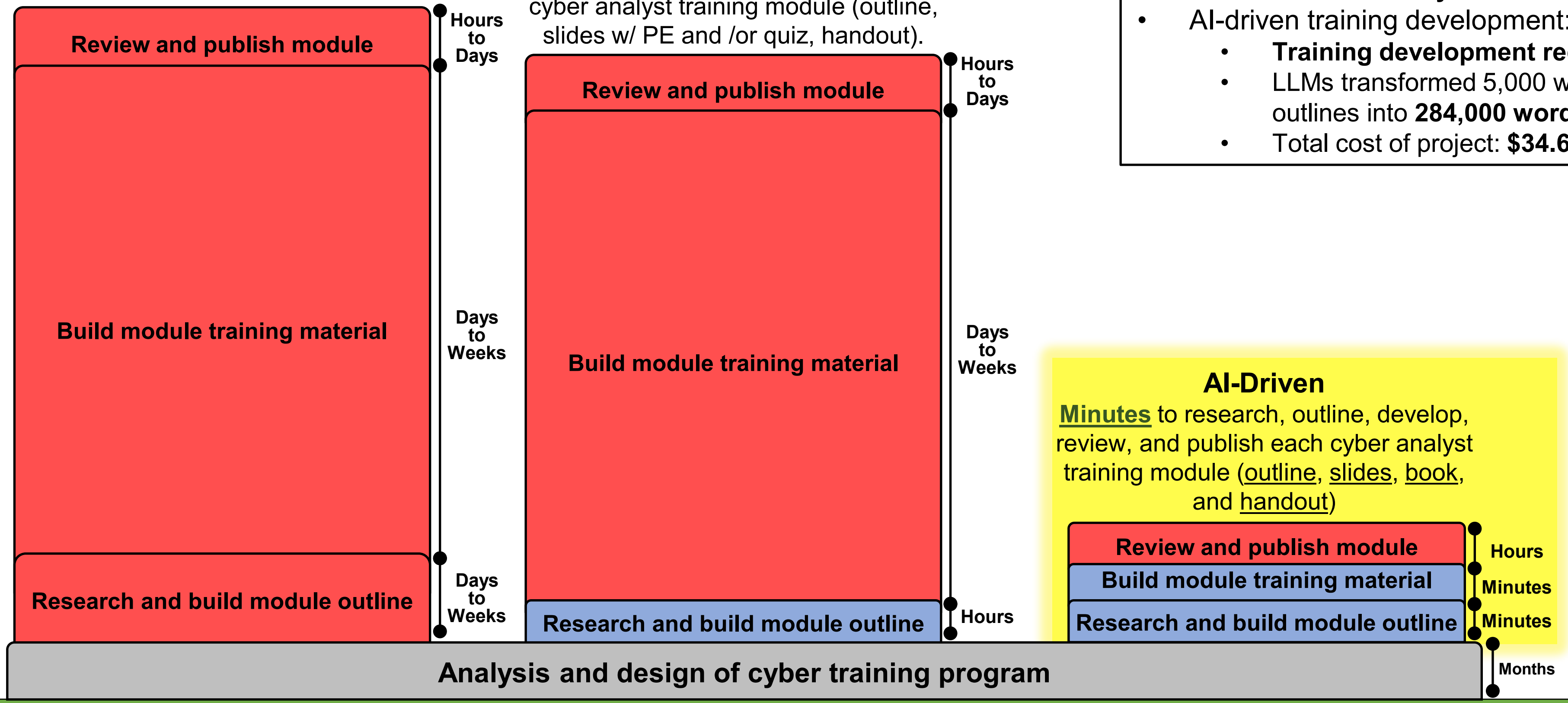

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Days to Weeks

AI-Enabled

1 to 2 months to research, outline, develop, review, and publish each cyber analyst training module (outline, slides w/ PE and /or quiz, handout).

Review and publish module
Hours to Days
Build module training material
Days to Weeks
Research and build module outline
Hours

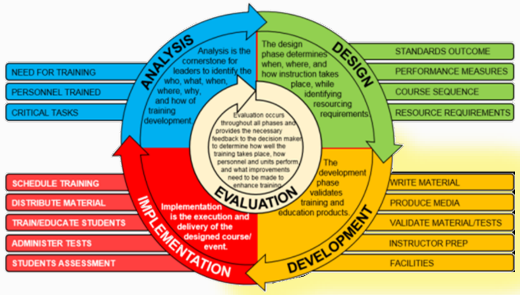
AI-Driven

Minutes to research, outline, develop, review, and publish each cyber analyst training module (outline, slides, book, and handout)

Review and publish module
Hours
Build module training material
Minutes
Research and build module outline
Minutes
Analysis and design of cyber training program
Months

Key Data Points & Results

- Started with ~5,000 words in module descriptions (prompts).
- Manual training development:
  - 1 to 2 months to research, outline, develop, review, and publish **each** cyber analyst training module.
  - **Estimated ~1 year to develop entire unit-internal training pipeline.**
- AI-enabled training development:
  - **Optimizing for the wrong constraint** led to similar 1 to 2 months to research, outline, develop, review, and publish **each** cyber analyst training module.
  - **Estimated ~1 year to develop entire unit-internal training pipeline.**
- AI-driven training development:
  - **Training development reduced to minutes.**
  - LLMs transformed 5,000 word module descriptions into 60,000 words of outlines into **284,000 words on 1,600** slides of course material.
  - Total cost of project: **$34.68**



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TRAIN/EDUCATE STUDENTS
ADMINISTER TESTS
STUDENTS ASSESSMENT

"Future Army forces require the capability to **rapidly understand, develop, and implement** training and education changes in order to meet shifting operational demands in the MDO environment. (paras 3-6.b and 3-8.b.)" – TRADOC Pamphlet 525-8-2

Accelerated Training Development Process

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Manually create training module title and description.

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- Not necessarily *the* answer, but a good start.
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  - Prompt GPT4 to explain topic.
  - Append output to LaTeX slide deck.
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Ensemble Model Approach

- **ChatGPT**: Web interface and long context window makes this particularly well-suited to **human-in-the-loop iteration.**
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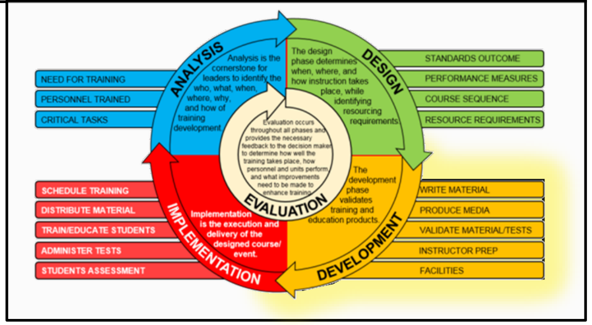

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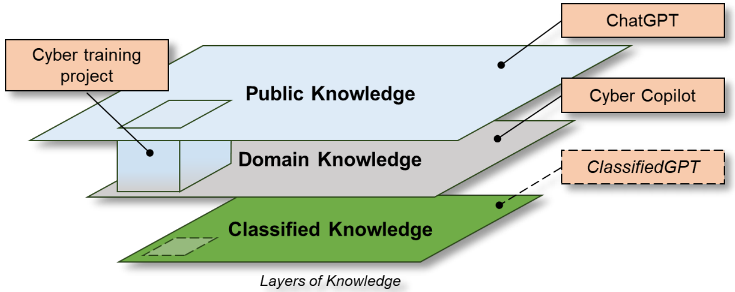

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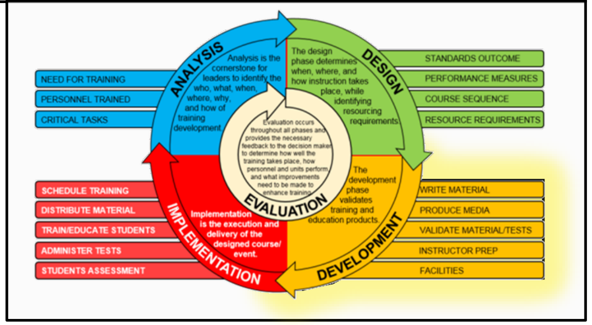

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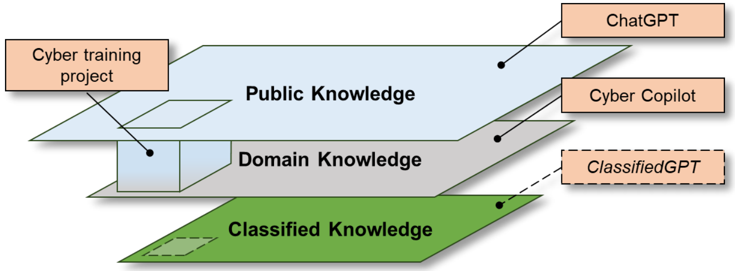

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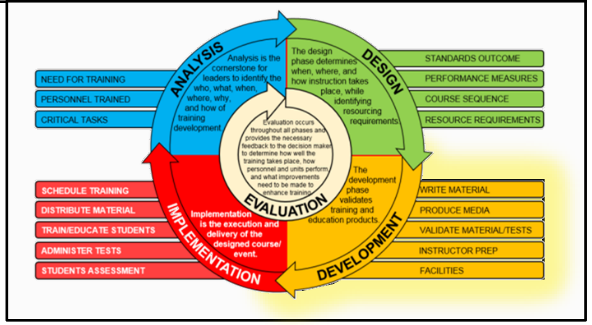

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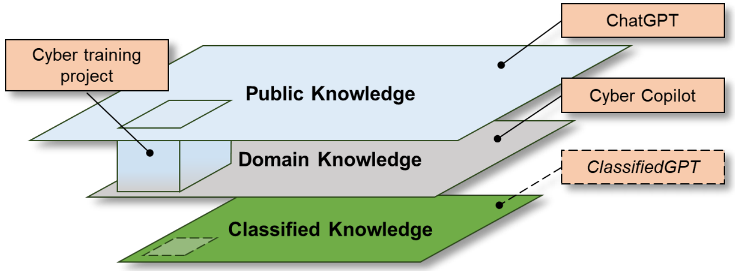

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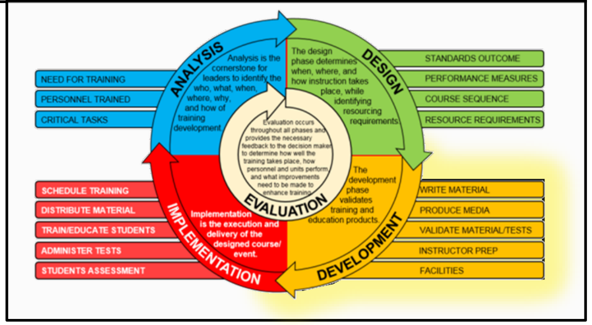

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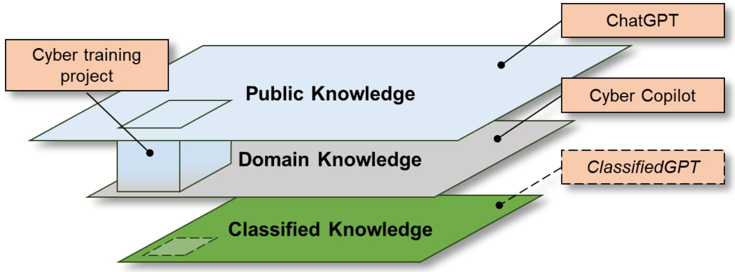

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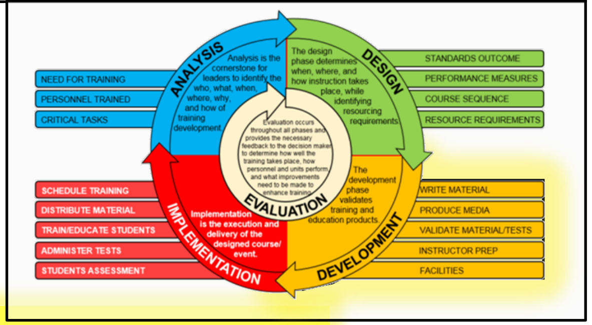

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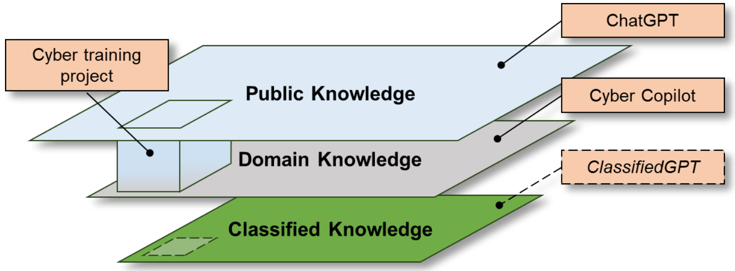

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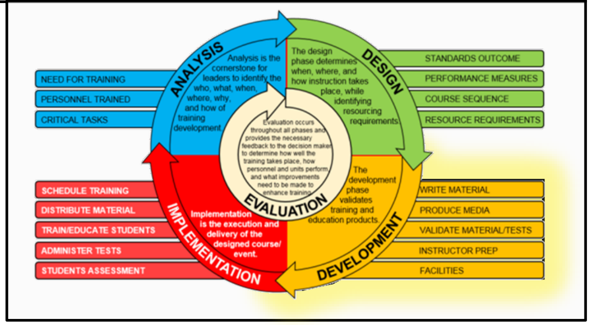
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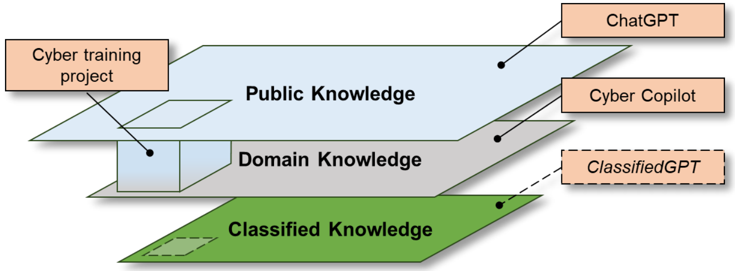

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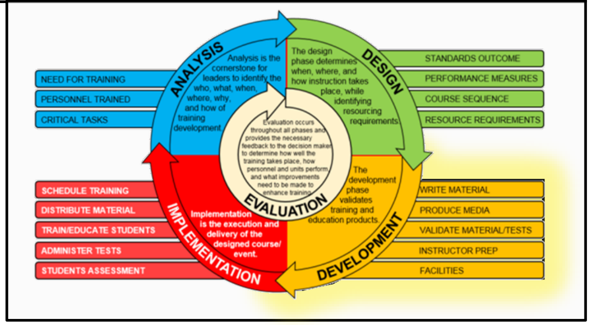
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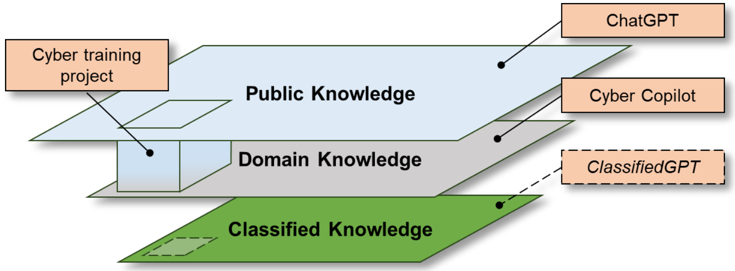
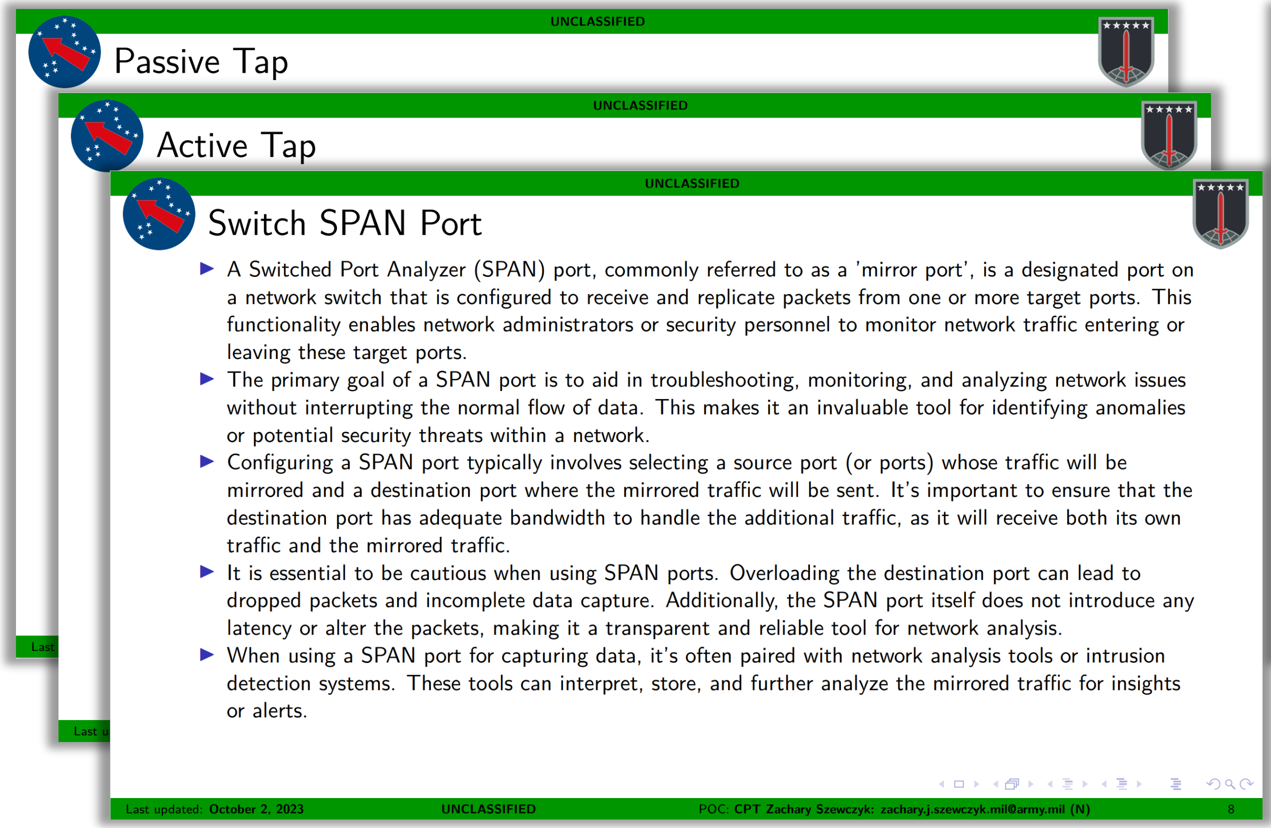


Layers of Knowledge

AI- Versus Human-Generated Training Material



UNCLASSIFIED

Passive Tap

UNCLASSIFIED

Active Tap

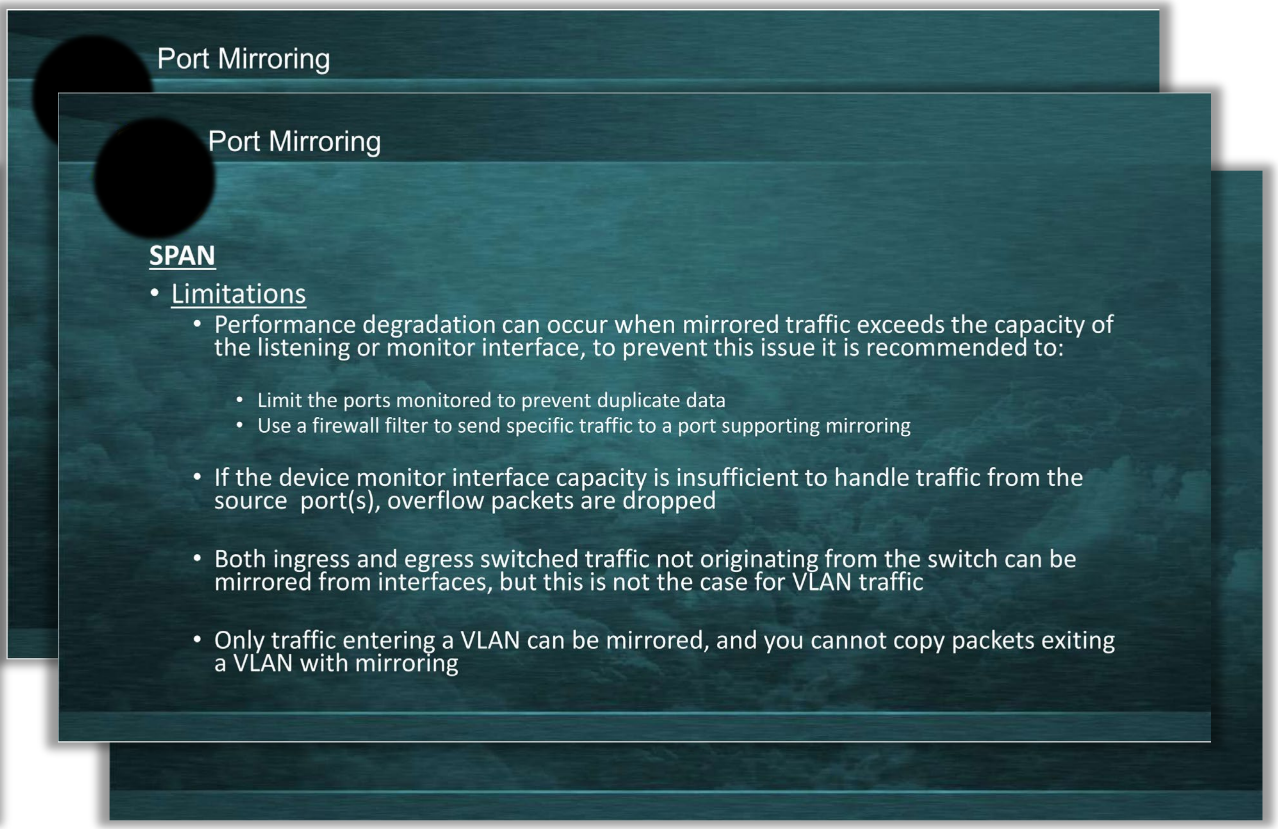
UNCLASSIFIED

Switch SPAN Port

- A Switched Port Analyzer (SPAN) port, commonly referred to as a 'mirror port', is a designated port on a network switch that is configured to receive and replicate packets from one or more target ports. This functionality enables network administrators or security personnel to monitor network traffic entering or leaving these target ports.
- The primary goal of a SPAN port is to aid in troubleshooting, monitoring, and analyzing network issues without interrupting the normal flow of data. This makes it an invaluable tool for identifying anomalies or potential security threats within a network.
- Configuring a SPAN port typically involves selecting a source port (or ports) whose traffic will be mirrored and a destination port where the mirrored traffic will be sent. It's important to ensure that the destination port has adequate bandwidth to handle the additional traffic, as it will receive both its own traffic and the mirrored traffic.
- It is essential to be cautious when using SPAN ports. Overloading the destination port can lead to dropped packets and incomplete data capture. Additionally, the SPAN port itself does not introduce any latency or alter the packets, making it a transparent and reliable tool for network analysis.
- When using a SPAN port for capturing data, it's often paired with network analysis tools or intrusion detection systems. These tools can interpret, store, and further analyze the mirrored traffic for insights or alerts.

Last updated: October 2, 2023 UNCLASSIFIED POC: CPT Zachary Szewczyk: zachary.j.szewczyk.mil@army.mil (N) 8

AI-Generated Training Material



Port Mirroring

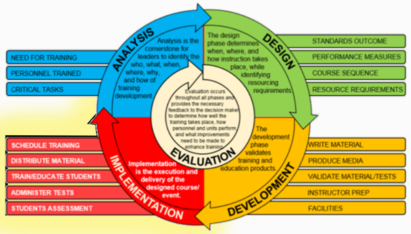
Port Mirroring

SPAN

- Limitations
  - Performance degradation can occur when mirrored traffic exceeds the capacity of the listening or monitor interface, to prevent this issue it is recommended to:
    - Limit the ports monitored to prevent duplicate data
    - Use a firewall filter to send specific traffic to a port supporting mirroring
  - If the device monitor interface capacity is insufficient to handle traffic from the source port(s), overflow packets are dropped
  - Both ingress and egress switched traffic not originating from the switch can be mirrored from interfaces, but this is not the case for VLAN traffic
  - Only traffic entering a VLAN can be mirrored, and you cannot copy packets exiting a VLAN with mirroring

Contractor-Generated Training Material

AI won't obviate the need for skilled course designers and knowledgeable instructors, but it can produce training material at least as good as what we have today.


ANALYSIS
Analysis is the cornerstone for leaders to identify the who, what, when, where, why, and how of training development.
NEED FOR TRAINING
PERSONNEL TRAINED
CRITICAL TASKS
DESIGN
The design phase determines when, where, and how instruction takes place, while identifying resourcing requirements.
STANDARDS OUTCOME
PERFORMANCE MEASURES
COURSE SEQUENCE
RESOURCE REQUIREMENTS
EVALUATION
Evaluation occurs throughout all phases and provides the necessary feedback to the decision maker to determine how well the training takes place, how personnel and units perform, and what improvements need to be made to enhance training.
DEVELOPMENT
The development phase validates training and education products.
WRITE MATERIAL
PRODUCE MEDIA
VALIDATE MATERIAL/TESTS
INSTRUCTOR PREP
FACILITIES
IMPLEMENTATION
Implementation is the execution and delivery of the designed course/ event.
SCHEDULE TRAINING
DISTRIBUTE MATERIAL
TRAIN/EDUCATE STUDENTS
ADMINISTER TESTS
STUDENTS ASSESSMENT

Key Takeaways

1. This project has already had significant impact at the **tactical level** but could have a greater impact **across echelons** and **across the force**.
    - The Army has many programs to teach specialists to create lesson materials in the institutional domain, but few opportunities for that training in the operational force.

2. This project **automates the mundane work** of basic information gathering and product creation. It enables **focusing on higher order tasks.**
    - Evaluating the effectiveness of training programs.
    - Improving the quality of training.
    - Integrating emerging research from academia and lessons from the operational force in a far more rapid manner than is done today.

Questions, Comments, & Closing

💡 *All the code for this project is hosted on US Cyber Command’s GitLab server, R2D2, here: https://code.levelup.cce.af.mil/3mdtf/idco/training*