INL/MIS-25-84557-Revision-0

Responsible Use of Cloud Solutions - Community of Practice Meeting

April 2025

Julia Catherine Morgan, Emma Mary Stewart, Abby M. Neumann

Changing the World's Energy Future

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Idaho National Laboratory
Idaho Falls, Idaho 83415

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Responsible Use of Cloud Solutions

Enabling Resilient Reliable Secure Cloud Deployments

DOE GDO Project

COP Meeting 3

Emma Stewart (INL) – Julia Morgan and Abby Neumann

GDO PM: James Briones (DOE), Jessica Whitaker (DOE)

Goal & Schedule – Community Of Practice

- Bring technical and strategy like minded folks together to talk about framework direction and advise
- Cirrus technical team will bring part of the framework being developed to each discussion
- 15 mins of discussion/input on a problem

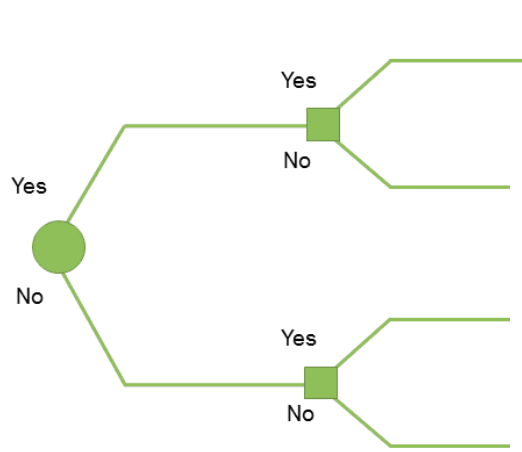
- **OUTLINE**
  - How is Cyber-Informed Engineering applied in Cirrus?
  - Ideas
    - Talk about Cyber-Informed Engineering (CIE)
    - CIE in Cirrus
    - CIE Analysis Output
    - User Interface Updates
  - Timing of next COP

Framework Design Principles

- Consequence-Driven
- Cost/Benefit at every layer of analysis
- Tailored to stakeholder user and type – critical functions
- Forward looking
- Applicable to emerging use cases in grid and digital modernization
- **Cyber-Informed**
- Explainable
- Repeatable
- Enable ability to unlock potential modernization paths

Goal of Cirrus

- Develop & Test a consequence driven **decision support framework** for
- Dynamic assessment for entities to strategize their grid **modernization deployment strategy** in the cloud
- Test against use cases & partner users enabling adequate assessment of deployment plans



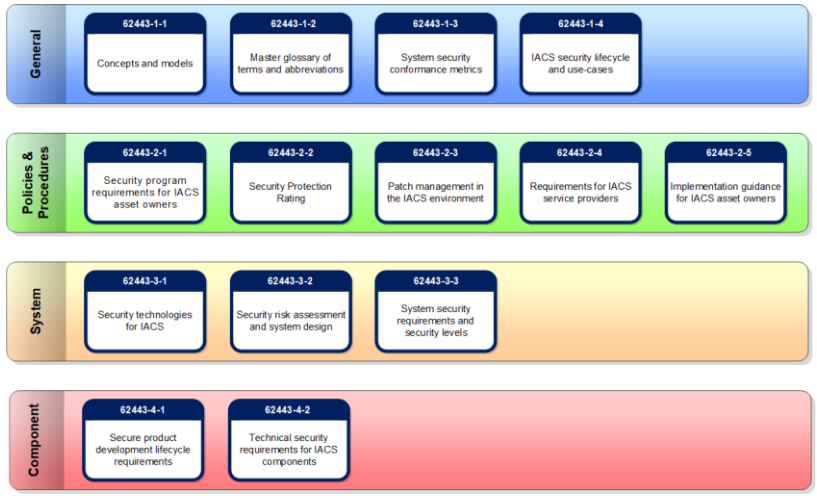
Cyber-Informed Engineering (CIE)

- CIE uses **design decisions and engineering controls** to eliminate or mitigate avenues for cyber-enabled attack.
- CIE offers the **opportunity to use engineering to eliminate specific harmful consequences** throughout the design and operation lifecycle, rather than add cybersecurity controls after the fact.
- Focused on **engineers and technicians**, CIE provides a framework for cyber education, awareness, and accountability.
- CIE aims to create a **culture of security** aligned with the existing industry safety culture.

Cyber-Informed Engineering (CIE)

Principle	Key Question
Consequence-Focused Design	How do I understand what critical functions my system must ensure and the undesired consequences it must prevent?
Engineered Controls	How do I implement controls to reduce avenues for attack or the damage which could result?
Secure Information Architecture	How do I prevent undesired manipulation of important data?
Design Simplification	How do I determine what features of my system are not absolutely necessary?
Layered Defenses	How do I create the best compilation of system defenses?
Active Defense	How do I proactively prepare to defend my system from any threat?
Interdependency Evaluation	How do I understand where my system can impact others or be impacted by others?
Digital Asset Awareness	How do I understand where digital assets are used, what functions they are capable of, and our assumptions about how they work?
Cyber-Secure Supply Chain Controls	How do I ensure my providers deliver the security we need?
Planned Resilience	How do I turn “what ifs” into “even ifs”?
Engineering Information Control	How do I manage knowledge about my system? How do I keep it out of the wrong hands?
Cybersecurity Culture	How do I ensure that everyone performs their role aligned with our security goals?

OK, But How Do You CIE?



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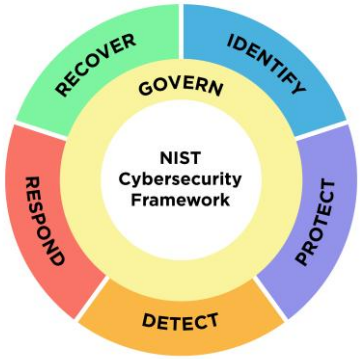

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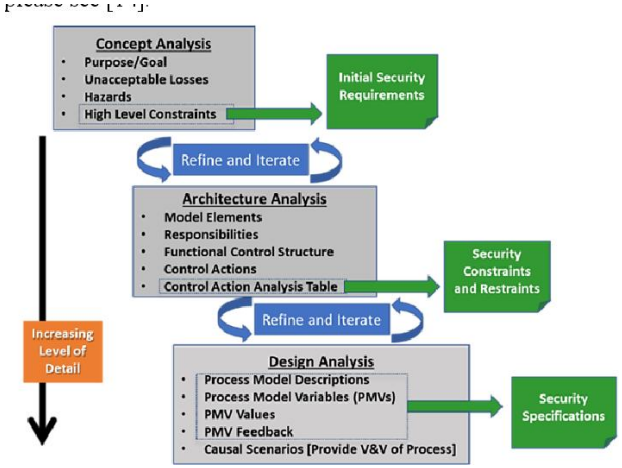
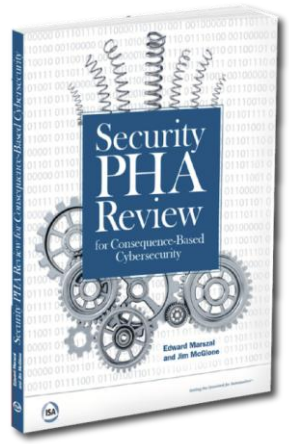
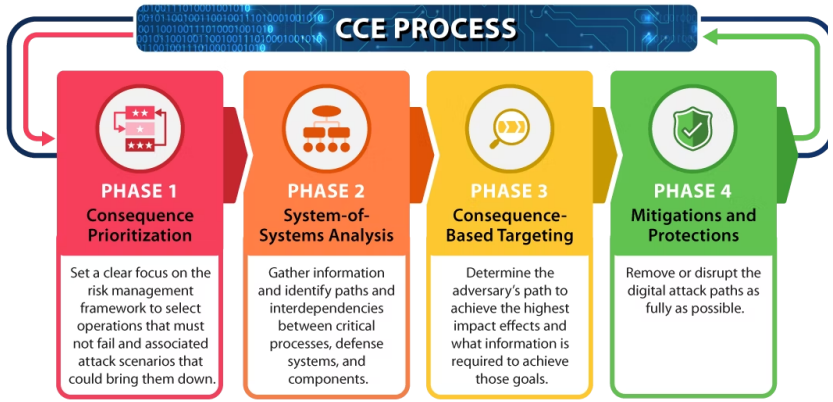
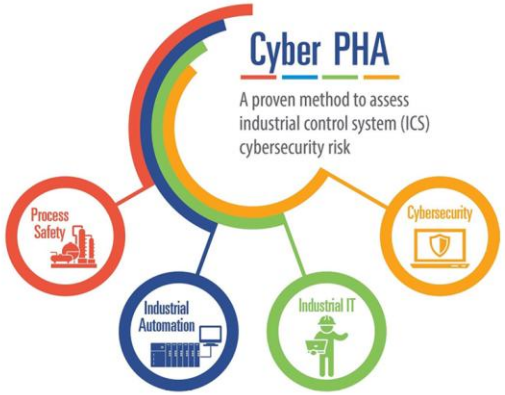


https://incose.onlinelibrary.wiley.com/doi/epdf/10.1002/j.2334-5837.2021.00839.x

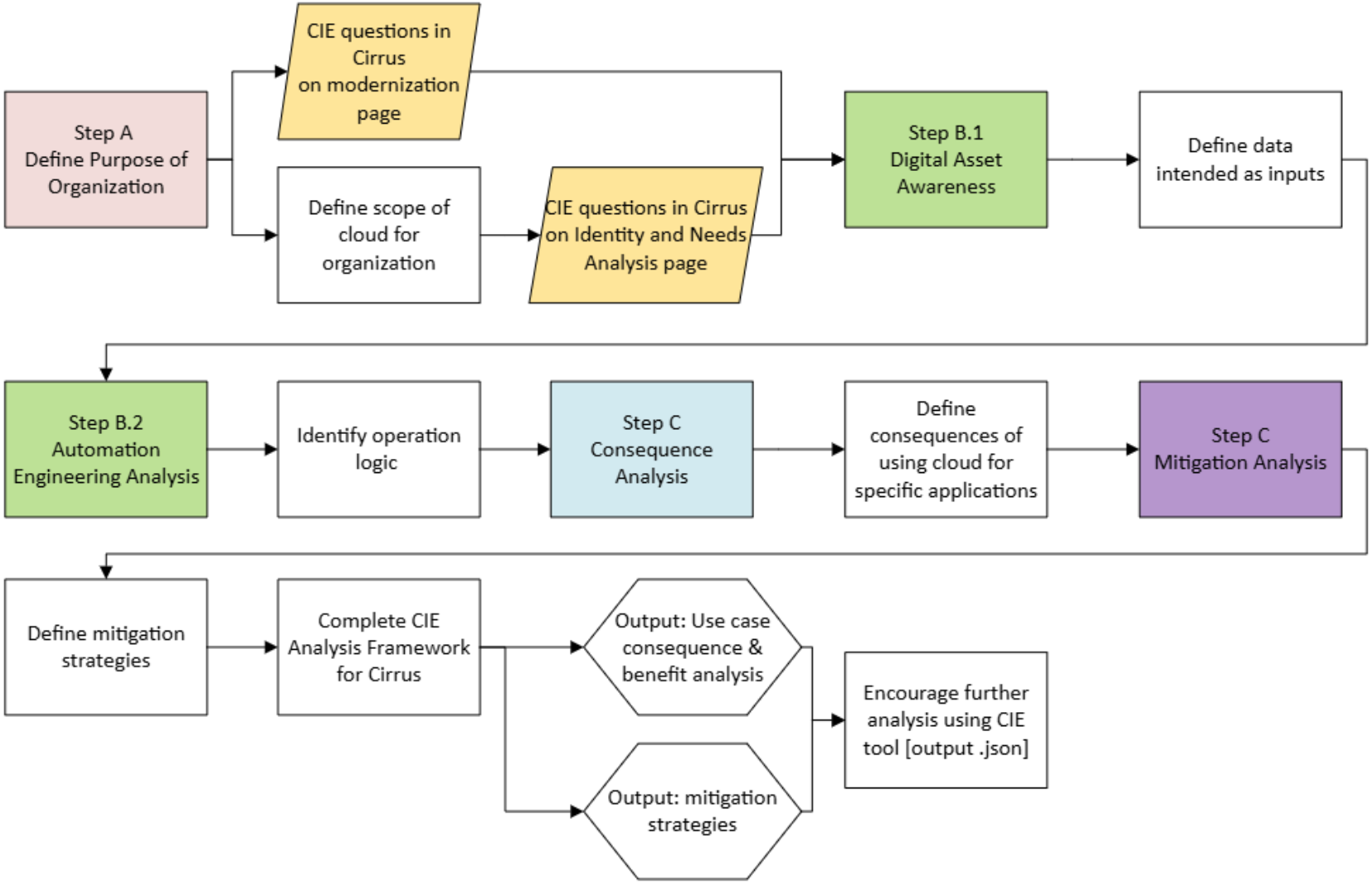






https://www.linkedin.com/pulse/cyber-pha-perfect-technique-ensure-your-safety-sis-kramer-mba/

CIE in Cirrus



CIE Questions in Cirrus

CIE Step	CIE Question	Cirrus Step	Cirrus Question(s)
Define Purpose of Organization	Define the purpose of the X system	Identity and Needs Analysis	• Business Model • Transmission & Distribution
Define Purpose of Organization	What parts of the design will contain X components or subcomponents?	Identity and Needs Analysis	• Existing cloud status • Do you use an MSSP or MSP?
Digital Asset Awareness	How are digital assets used to meet system requirements?	Modernization Strategy	• What applications are being deployed by your organization?

- This is not a full list of all CIE questions in Cirrus, just a brief demonstration of overlap
- Many of the CIE questions ask ‘how’ – Cirrus needs to know ‘what’ AND ‘how’

Use Case Consequences & Benefits Analysis

Table 1: Example consequence table and weighting.

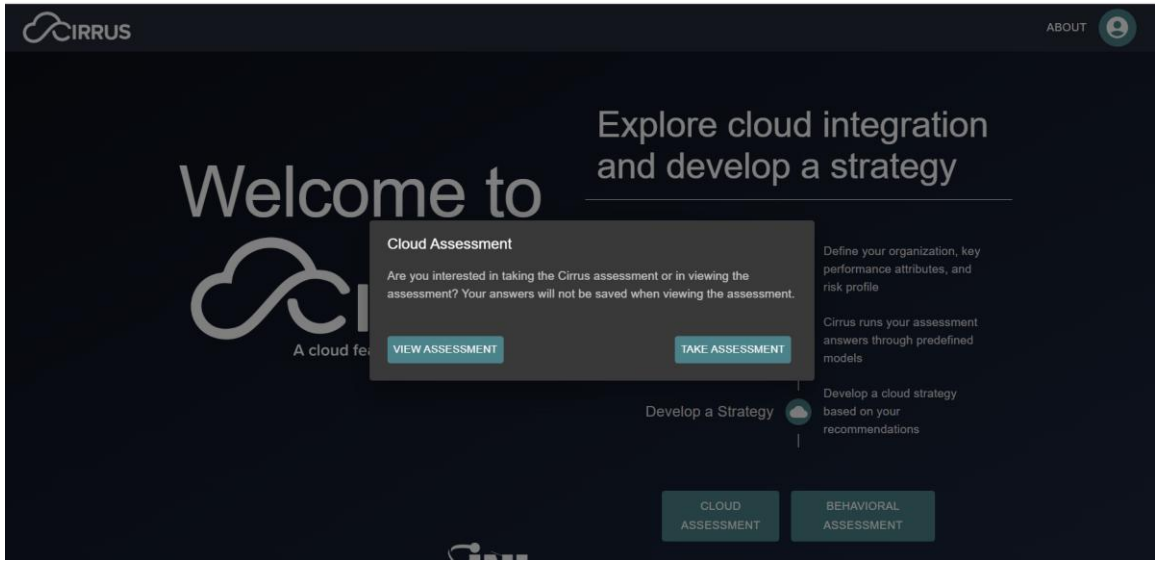
Criteria	None	Low	Medium	High
Area/Load Impact	Inconsequential	Loss of failure to service firm load of less than XMW	Loss of failure to service firm load between X+1 and Y MW	Loss of failure to service firm load greater than Y + 1 MW
Duration	Inconsequential	Return of all service in less than 1 day (inability to serve firm load) or supply outage for less than one week	Return of all service 1 – 5 days (inability to serve firm load) (or) supply outage for 1 week – 1 month	Return of all service >5 days (inability to serve firm load) (or) supply outage >1 month
Safety	Inconsequential	Risk onsite	Definite safety risk offsite	Loss of life potential
Cost	Inconsequential	Significant but can recover	Multiple years to recover financially	Trigger of liquidity crisis/potential bankruptcy

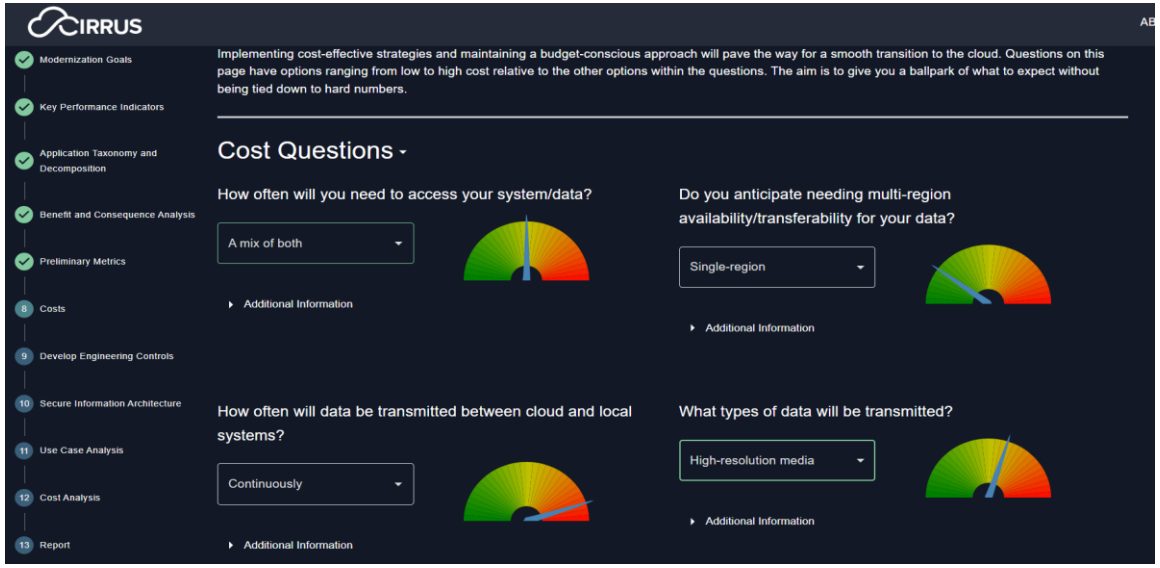
- Examine **interdependencies within the communication system** and establish redundancy requirements.
- Evaluate data throughput and storage needs, considering the **cost implications** of interdependency, long-term and short-term storage, redundancy, and residency.

Risk Mitigation Strategies

- Introduce simplification by identifying essential features for the cloud deployment, exploring the possibility of reducing features to mitigate risks, and determining the most crucial aspects to mitigate High Consequence Events (HCE).
- **Phase in features gradually** with a heightened review of equipment capabilities over time, minimizing elements at risk for mission-critical functions in the initial deployment.
- Determine the minimum viable set of information to maintain operation in the event of service interruption to maintain consistent core data for analysis.
- Based on the insights gained from Secure Information Architecture and Digital Asset Management Planning (in Cirrus),
  - Data ownership guide for users to reference to address data integrity and compliance.
  - Outline cloud-handling types and offer **guidance on enhanced information protection considerations**
    - Public
    - Private
    - Hybrid
    - IaaS
    - PaaS
    - Saas

Cirrus User Interface Updates





Publication Updates and Next Meeting

- Next meeting
  - June 12th?
  - June 19th?
- Final meeting
  - September 18th?

Artifact Type	Publication, Report, Presentation, Paper, Conference, etc. Title	Publication Date	External Publication Link (Including OSTI)
Conference Papers	Evaluation and Use Cases in Cloud Implementation for Future Electric Grid Technologies	July 21, 2024	https://ieeexplore.ieee.org/document/10688615
Technical Reports	Lessons Learned for Responsible Use of Cloud in the Cirrus Project, Following the CrowdStrike Outage Event	October 11, 2024	https://www.osti.gov/biblio/2482012
Technical Reports	Enhancing Cloud Cybersecurity: Prescriptive Controls for Operational Technology	October 22, 2024	
Conference Papers	Consequence Based Framework for Deployment of Cloud Solutions in the Digital Energy Transition	January 21, 2025	https://ieeexplore.ieee.org/document/10887455 https://www.osti.gov/biblio/2510493
Conference Papers	Improving Cybersecurity and Resilience through Cloud Technology Implementation	February 4, 2025	

Idaho National Laboratory

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IAB & COP Charter

- **Publication**
  - The IAB members have the right to publicize the fact of their participation in the IAB. They have the right to disseminate work products from the projects, provided that the work products have been cleared for release by the laboratory and DOE GDO.
- **Responsibilities**
  - The IAB members are responsible to attend bi-annually virtual meetings (once every six months) to provide feedback as requested of them and to review the work products (if any). IAB members are also responsible to not disclose their own company's proprietary or other sensitive information during IAB meetings or in their written feedback. The Community of Practice will meet online monthly. Attendance is encouraged but not required, and will be intended to guide the future of this work in cloud implementation.
- **Meetings**
  - The project team will host bi-annually virtual IAB meetings to solicit the feedback. The IAB members are also encouraged to join the annual in-person continuation review meeting.
- **Commitment**
  - The project team estimates that IAB members are not expected to spend more than 2 hours on IAB work every month. The actual time may vary from month to month.
- **Term of Membership**
  - The IAB will exist for the duration of the project, which is scheduled to end September 2024. The minimum expected term of IAB membership is one (1) year.

Use Case Descriptions – general details about implementation factors to decide cloud benefits and purpose

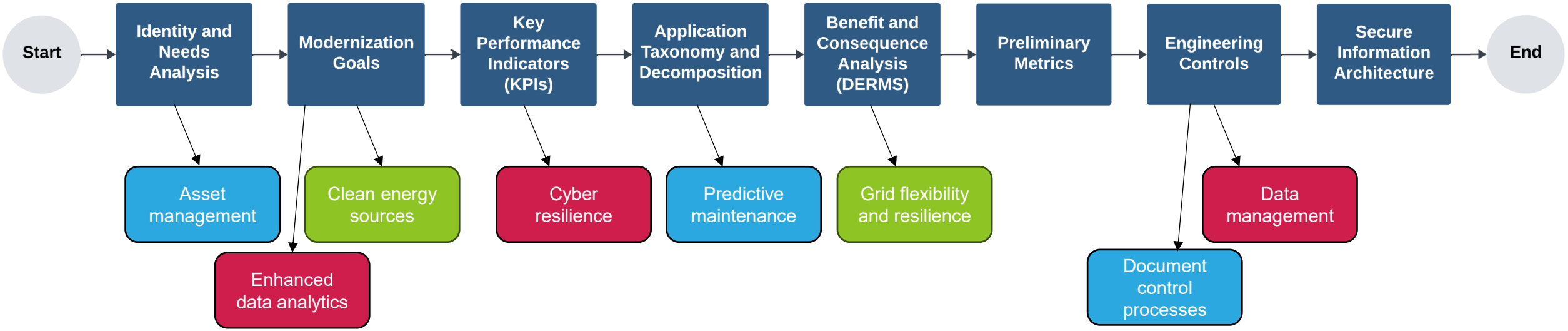
- Security and Compliance
  - Cloud-based cybersecurity solutions can provide robust protection against cyberattacks, data breaches, and unauthorized access to sensitive information. Cloud providers offer advanced security measures, including encryption, firewalls, and intrusion detection systems, to safeguard utility data and comply with industry regulations.
    - Increased penetration of renewable energy sources.
    - Improved grid flexibility and resilience.
    - Reduced reliance on traditional fossil fuel-based generation.

- Reliability and Planning
  - Reliability and planning models are crucial for utility distribution systems to ensure the efficient and reliable operation of power grids. Reliability models focus on analyzing the performance and dependability of the distribution system by assessing the probability of component failures, identifying potential causes, and estimating their impact on the overall system. Utilities use reliability models in the following ways:
    - Equipment maintenance and asset management to share data between entities for better analytics (improve size of the data pool for advanced functions that do not work with small silos).
    - Reliability and planning model.
    - Engineering drawing management.

- Grid Management and Optimization
  - Cloud-based solutions can provide real-time visibility into grid operations, enabling utilities to optimize power distribution, manage demand fluctuations, and prevent outages. Cloud-powered analytics can analyze vast amounts of data from sensors and smart meters to identify patterns, predict potential disruptions, and implement proactive measures. Benefits associated with grid management and optimization include the following:
    - Advanced Distribution Management Systems
    - Smart Metering and Enhanced Data Analytics
    - Distributed Energy Resource Management System
    - Equitable Technology Access and Cyber Resilience
    - Data Management and Planning Tools

Use Case – Intention for assessment taker

- How do we use existing information for analysis?
- Do we need to expand the assessment for more effective analysis?



Use Case – Participant and Data Relation

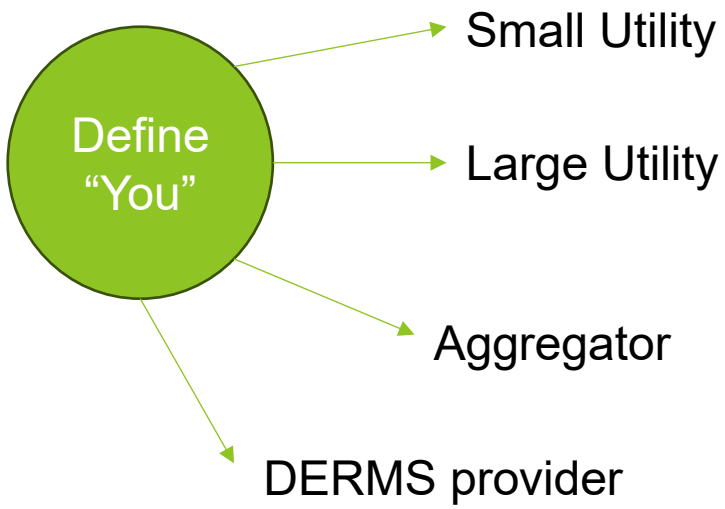
How do we associate observed information with actionable items?

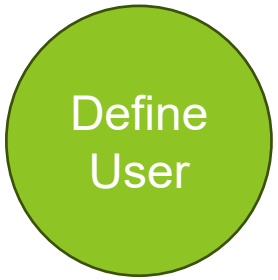
1. Technical vs. visual output
   - Suggested actions based on category (previous slide)
   - Static information based on assigned use case
   - etc
2. Pros and Cons – thoughts?
3. Characteristics associated with cost
   - Evaluation of utility (function vs. purpose)
   - Identify significant annual costs
     - Business expenses (stakeholder engagement)
     - Alternative energy sources
     - Physical safety
     - Cyber safety
     - Systems and Services
       - Operational maintenance

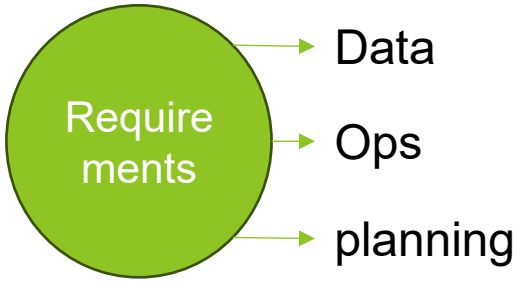
Stakeholders

- Small/medium utilities building modernized infrastructure
  - Overall digital infrastructure shift
  - Board report
- Utility Staff Planning Deployment of Advanced Applications
  - Determine if cloud is the right choice
  - Cost targets
  - Initial planning framework
  - Find the right questions to ask the third party/vendor
- Decision makers
  - NERC CIP? Regulated? Non Regulated?
- Third Party integrators
  - DERMS Software, ADMS provider, start up/new applications
  - Cloud or not cloud and what requirements will there be

Example Types of Questions in the Decision Support Framework







Consequence (its good and bad)

What is the purpose of the proposed system

How does it support the org

What sys processes exist for this function

What sys processes if they fail or operate incorrectly, will cause the purpose to fail

What are the mission critical functions it must perform

What aspects of the CONOPS enable the functions

What needs does it address in the system and how does it do that?

What short term outcome is needed from this application (metrics for success)

Net zero targets

Cost reduction

Improve security

What Consequences from failure or unexpected operations

Impact to delivery, safety, security, the environment, property, financials, or corporate reputation

What happens if multiple consequences at once

Plan for engagements

- 3 x IAB Meeting – 1 year (inc kick off)
  - Online (Feb 28 – potentially in person @ dtech?)
  - 1 in person
  - Poll for common in person events
- Monthly COP Meetings (No 1. Dec 6 or 7)
  - Online Teams Forum
  - Review progress
  - General discussion on cloud applications
  - Beta test
- Publications
  - Roadmap for review
- Resilience Week Meeting (Nov 27 – 29 in DC)

Outreach Events

- Distributech
  - Planned workshop
- IEEE PES GM (July 2024)
  - Paper/Panel
- Gridwise Alliance (Dec)
  - Attendance
- RSA Submitted (May 2024)
  - Panel
- RE+ Submitted
  - Workshop
- Clean Energy Cyber con? (Feb)
- SANS ICS 2024 (Orlando?)

- Trade Events
  - APPA National Meeting (June)
  - ACP National Meeting (May 6 – 9)
  - EEI National Meeting (June)
- EV Charging Expo and Summit?
- Cloud Company Events
  - AWS Summit 2024 (June 26 + 27)
  - Google Cloud Next 2024 (Aug 29 – 31 LV)
- ESIG Workshops

Feedback & Homework

- Guiding the features and decision support?
- Joining the COP
- In person Event choice?

8. CIE Principles (Website/tool will have a guide to each of these and how to work through it)

PRINCIPLE	KEY QUESTION
Consequence-Focused Design	How do I understand what critical functions my system must ensure and the undesired consequences it must prevent?
Engineered Controls	How do I implement controls to reduce avenues for attack or the damage which could result?
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