Bureaucratic Affairs Building

Assessment Phase Module

Scoping Webinars and Self Study Guidance Document

Document Navigation

If you are using the electronic version of this document, you can quickly navigate through it by using the hyperlinks that are built into the Table of Contents and References to Figures or Headings in the document.

More specifically, if you hover your mouse over an item in the contents in Adobe Acrobat, you will notice that you will get a pointing finger icon that lets you click on the item and jump to the topic. In Word, you will get a message window with the link that tells you to use Ctrl+Click to follow the link. A similar thing will happen if you hover over a reference to a figure or a reference to a different section of the document.

Introduction

This document provides guidance for the scoping webinars within the CERL EBCx Academy's Assessment Phase Module. The module includes two main webinar sessions, one focusing on hydronic systems and the other on air systems, supplemented by a follow-up check-in session for attendees to discuss their progress on assignments.

During the interactive webinars, attendees will work in teams to begin scoping the target systems and developing a findings list. This document is intended to be used as a reference for webinar preparation and subsequent self-study assignments.

Note that the document is divided into two general sections.

1. The body of the document (approximately the first 8 pages including the table of contents below) contains the fundamental information you need to be familiar with in order to be prepared for the webinars, including a link to a video that you need to watch which will show you how to work in 3DVista – the software platform we use for our virtual learning environment.
2. The remainder of the document includes links to supplementary resources providing additional information on a number of topics for those who want to take a deeper dive.

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Introduction to Using 3DVista

Webinars and assignments will use 3DVista software, commonly used for virtual real estate tours, to provide a web-based training experience without requiring attendees to have specialized 3D software. The video guide associated with the link below explains and illustrates how we will use 3DVista virtual models for various learning activities.

3DVista Guidance - How We Will Use 3DVista in Class and How You Navigate In It

The video includes examples of each activity type we will use in the class along with links to practice models that will allow you to become comfortable working in 3DVista prior to class.

> *The ability to work in 3DVista will be essential to your learning experience. Thus, it is essential that you watch the video and try your hand at navigating in one or more of the models prior to the first webinar session where they will be used.*

Note that the video includes a table of contents feature that lets you jump around to various points in the video, as illustrated in Figure 1.

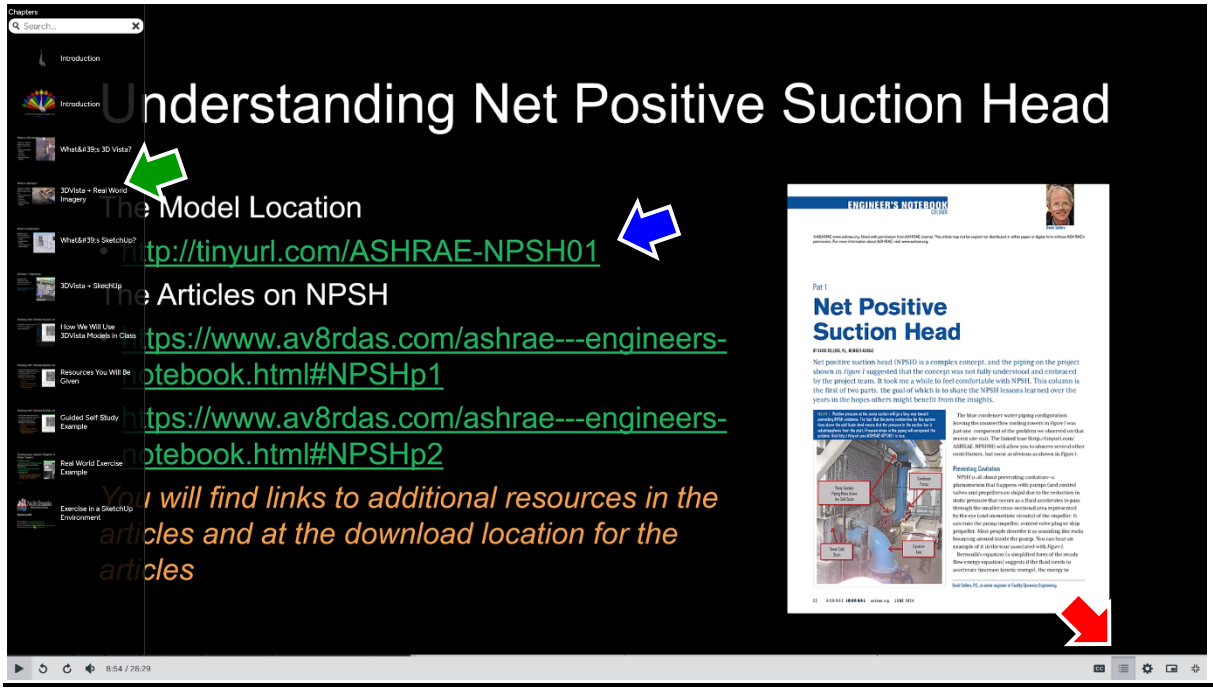

Figure 1 – Video Table of Contents Feature. Hovering your mouse over the video opens a tool bar. Clicking on the icon highlighted by the red arrow opens the table of contents panel highlighted by the green arrow. Clicking a thumbnail will jump you to that point in the video. Links in the video (blue arrow) are "live" and clicking on them should pause the video and jump you to the resource.

In the video, you will notice that there are links to practice models and related supplementary resources. For most users, the links should be "live", meaning you can click on them in the video, which will pause the video and jump you to the resource. But, if you find that does not work for your browser, all of the links have been reproduced in the *Supplemental Information Appendix* under *3DVista Example/Practice Models and Related Supplemental Information*.

Note also that on some government computer networks, the models may seem slow to respond or laggy when you try to navigate in them. If you experience this issue, please reach out to the lead instructors to make them aware of the problem so they can develop a solution.

You can also try using the link below, which will take you to a 3DVista tour of a different model that has been deployed inside a government network and has been proven to not have the lag issue.

https://cerl-mech.erdc.dren.mil/HijendV2/index.htm

The model is not one of the examples from the video, but the navigation concepts are the same and you can become familiar with them by working with it in place of the examples provided in the video.

Another option to get around the lag issue is to use a non-government computer to access the practice models.

Bureaucratic Affairs Building Model

The model we will use in the class is the Bureaucratic Affairs Building (BAB). The BAB is a fictional building designed to provide a virtual existing building commissioning experience, from scoping and investigation to implementation and verification. Links to the model and any related supporting information for class activities will be provided on the day before the specific activity occurs.

Bureaucratic Affairs Building Scoping Exercise Answer Keys

After the webinars and a check-in session, attendees will receive detailed answer keys for each of the focus systems. The keys will allow attendees to validate their findings, review opportunities they may have missed, and gain insight into the details behind each opportunity. By working through these common real-world examples, attendees will become familiar with how to identify and begin assessing opportunities on their own projects.

The guidance provided will focus on the clues that lead to the discovery of the opportunity (items 1 – 4 in the list below). The remaining items on the list below will also be touched upon since they relate to scoping. But they will be covered in depth in subsequent modules.

For each opportunity, the answer key provides:

1. A picture of the obvious indicator or field clue.
2. A description of the opportunity.
3. The opportunity location, typically represented in the model floor plan.
4. A brief list of related HVAC concepts, as understanding these provides a foundation for the scoping process.
5. A brief discussion of interactive/related findings, as a change to one component can impact others.
6. A list of potential savings categories, including non-energy benefits.
7. A brief discussion of the options for achieving savings. The intention is to make attendees aware of the options, which may impact how findings are prioritized.
8. Where appropriate, a brief description of how to go about making a preliminary field assessment of the savings potential for a given finding. This can help the practitioner to prioritize their findings list and firm up any initial savings projections for the project that were made using broad-brush techniques.[1]
9. A brief summary of data logging and functional testing recommendations. Data logging and testing will be significant parts of the assessment phase of the commissioning process and are major topics in the class. Thinking ahead a bit during the scoping phase in anticipation of what might be required down the road in terms of trend and test data for a given finding can streamline the subsequent process.[2]
10. A brief description of the implementation strategy associated with the opportunity. This is another topic that will be explored in much more depth as the class moves forward from the scoping discussion. However, having a sense of what will be required to develop a given finding can help the practitioner priorities the findings list and begin to target the resources that will be needed to move forward.

Learning Objectives

Attendees of the BAB Scoping Modules will be able to:

1. Recognize building performance issues from utility data analysis and benchmarking.
2. Recognize issues from field walkthrough.
3. Recognize issues from interactions with facility staff.
4. Distinguish issues with energy savings potential from measures without energy implications.

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[1] Guidance regarding how to develop an initial EBCx project savings assessment using utility cost data and industry metrics can be found in the *Supplemental Information Appendix* under *Making an Initial Project Saving Assessmen*t. The appendix also includes discussion about why taking a few moments during the scoping phase to make an initial finding specific savings estimate – where possible – can be beneficial.

[2] For more information on why this matters, refer to the *Supplemental Information Appendix* under *Why Should I Think Ahead to the Datalogging and Functional Testing Phase During the Scoping Phase?*

5. Sort repairs by system type.
6. Sort repairs that are inexpensive from capitally intensive measures.
7. Document findings with adequate level of detail including type of issue, date found, and person responsible for fix.
8. Attendees will recognize common clues provided by the fundamental HVAC relationships regarding resource efficiency targets
9. Attendees will recognize that the scoping process should include an effort to identify ways that a load profile can be developed for the systems that are targeted

Attendees will also discover in subsequent modules that there are a number of scoping related learning objectives that will be explored in those modules which are listed below so you can be aware of them during this module.

1. Attendees will recognize issues from system diagram development.
2. Attendees will recognize issues from EMS interface and control graphics.
3. Attendees will recognize issues from trend data analysis.
4. Attendees will recognize issues from functional testing.

Assumed Knowledge

Attendees are assumed to have completed the prerequisites from the HVAC Fundamentals, Excel Workshop, and Planning Phase modules. Please reach out to the lead instructors if you have yet to complete this work or have questions regarding how to access the related materials.

Scoping Module Self-Study

Flip the Classroom Concept

This class uses the “flip the classroom” concept. Students are provided with self-study resources to learn basic concepts before class, so that webinar time can be dedicated to interactive exercises that apply those concepts. Instructors will assume a baseline level of knowledge coming into the webinars.

Primary and Secondary Self-study Resources

Familiarity with the concepts in the primary self-study resources is essential. These include chapters from the Army RCx Technical Guide, CERL target lists, and introductory videos[3]. Secondary resources are also available for those interested in a "deeper dive" into the scoping topic and can be found in the *Supplemental Information Appendix* under *Secondary Self-study Resources*.

[3] For those who are not familiar with these resources, links to the resources are provided in the *Supplemental Information Appendix* under *Primary Self-study Resources*.

Pre-webinar Self-Guided Study and Time Commitments

In addition to reviewing this document and the *Introduction to Using 3DVista* video mentioned previously, attendees should watch the *Introduction to the Bureaucratic Affairs Building* video provided at the link below.

Bureaucratic Affairs Building Operator Interview and Walk-through

In a real world EBCx project, you would typically spend several hours to a day (maybe more for a large site) meeting with the team operating the facility and touring it to begin to get up to speed and initiate the scoping process. The video is intended to provide a virtual version of the operator interview and building walk-through experience for the Bureaucratic Affairs Building. This video also includes hot links and the table of contents figure as illustrated in Figure 1

The video references other information like a copy of the slides that the energy manager presents. These materials can be found at this link if the link in the video does not work on your system.

Bureaucratic Affairs Building Documentation and Information

Materials will be added to this location as the class progresses so you may want to check it occasionally to be sure you have everything. In addition, the instructors will notify you if information you will need for an upcoming webinar or class has been added.

The anticipated time commitment for this preparatory work will vary depending on your level of familiarity with the *Primary Self-study Resources*, and how much time, if any, you spend with the *Secondary Self-study Resources*. but is estimated to be between 90 and 120 minutes in total.

Exercise Materials

Webinar Specific Materials

The lead instructors will provide a link to the 3DVista tour associated with the webinar on or before the day before the webinar occurs. Each webinar will use a different model that is focused on the webinar topic. Attendees should ensure that they have access to this resource prior to the start of the webinar by opening it and attempting navigation in it.

Other webinar specific resources like spreadsheets, video clips, blog posts, etc. will typically be distributed via links during the webinar or uploaded to the class Teams site prior to the webinar. Follow up materials will be shared in the class Teams site subsequent to the webinar.

In Case of Difficulty

Please contact the lead instructors if you have difficulty accessing any materials or have issues with any of the 3DVista models running on your machine as soon as you are aware of them.

For you to achieve maximum benefit from the interactive webinar session that work with the models, it is essential that they be running smoothly on your machine and that you are comfortable with the basic navigation skills required to move around in them.

Webinar Activities

The webinars will focus on instructor-guided discussions and teamwork in breakout sessions. Attendees will apply scoping concepts by exploring the BAB's chilled water system and central station AHU to begin developing a findings list. It is likely that two or three opportunities will be identified and discussed in each webinar.

Post Webinar Self-Guided Study

Following the webinars, attendees will be assigned to continue exploring the BAB model to identify additional opportunities and expand their findings list. During a subsequent check-in session, you will discuss your findings with instructors before receiving a detailed answer key. This key will validate your observations, provide examples of other common findings, and offer insights on how to move forward with the opportunities that exist in the BAB. The opportunities in the BAB are quite common, so it is likely that some of them will exist in the facilities you are working with.

Supplemental Information Appendix

3DVista Example/Practice Models and Related Supplemental Information

The links below will take you to the example/practice models used in the *Introduction to Using 3DVista* video along with the related supplemental information resources that were mentioned.

Guided Self Study Example

Model Link

Understanding Net Positive Suction Head

Related Supplemental Information Links

ASHRAE Engineer's Notebook - Net Positive Suction Head - Part 1

ASHRAE Engineer's Notebook - Net Positive Suction Head - Part 2

Real World Exercise Example

Model Link

Creating a Hot Water System Diagram

Related Supplemental Information Links

System Diagramming Self Study Videos and Resources

SketchUp Exercise Example

Model Link

Exploring and Scoping an Air Handling System

Related Supplemental Information Links

Scoping Resources

Benchmarking, Utility Analysis, and Scoping Self Study Video

Making an Initial Project Saving Assessment

The results of the utility analysis and benchmarking efforts undertaken early on in an EBCx project can be used to establish the approximate savings potential for the project by leveraging that data and industry metrics published in the LBNL Commissioning Cost/Benefit Reports. This can be further extrapolated to establish a preliminary budget for the EBCx efforts given some knowledge of the Owner's financial perspective on investing in resource conservation.

The blog post at the link below provides guidance regarding how to accomplish this along with related resources.

Developing Preliminary EBCx Budgets

Why Should I Make an Initial Field Assessment of the Savings Potential for a Finding if the Opportunity Presents Itself?

Since you or someone involved with the EBCx project will likely spend a significant amount investigating the findings via testing and trend analysis in order to develop savings projections, you may wonder why you should spend any time at all doing testing during the scoping effort.

The reason is that experience has demonstrated that this can be helpful for a number of reasons.

Firming Up Potential Savings Projections

The assessment technique discussed in this appendix under *Making an Initial Project Saving Assessment* projects cost/benefit based on very broad patterns observed in the facility's utility consumption in light of industry metrics for similar facilities based on a respected industry resource. But the bottom line on such an assessment is that you ***suspect*** opportunities exist that could deliver savings in a certain range based on some building specific information in the form of its utility patterns and the type of facility that it is.

But you don't know it for sure yet; that's why the assessment developed using the technique should be presented as a savings ***range*** vs, a specific number.

In contrast, if you can use few field clues for a specific observation to project the savings associated with it, then some of the ***suspected*** savings become ***likely*** or even ***firm*** savings.

For example, if you observe a preheat coil that is active when it should not be active and:

- Observe that the unnecessary temperature rise across the air side via existing instrumentation or measurements you take with a portable field instrument you brought with you is 2.5°F, and
- Estimate the flow rate in the system based on the cross-sectional area of the air handling unit to be in the range of 18,000 cfm

… then you can use the air side sensible load equation (Figure 2) to project how much thermal energy is being wasted at that instant in time.

If you discussed this with the operators and could get a sense of the flow profile, their cost for thermal energy, and about how many hours the system ran with this condition, then with a bit of practice, you could - standing there in the field - come up with a ballpark estimate of the savings potential associated with the observation.

In the case of the example, if the current gas rate was $0.87 per therm, then you just identified $0.42 per hour in savings. This may not sound like much until you consider that a system serving a facility like the BAB may run in the range of 3,500 hours per

year, meaning the annual savings potential is in the range of $1.460 if the valve leak was fairly steady state, which is often the case.

$$Q_{\text{Btu per hour}} = 1.08 \times Flow_{\text{Cubic Feet per Minute}} \times \left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)$$

Where:

$Q_{\text{Btu per hour}}$ = Sensible energy change in the air stream

1.08 = Unit conversion constant for dry air at 70°F

$Flow_{\text{Cubic Feet per Minute}}$ = The flow rate for the current operating mode based on TAB data

$\left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)$ = Heat exchanger temperature difference

$$Q_{\text{Btu per hour}} = 1.08 \times Flow_{\text{Cubic Feet per Minute}} \times \left(Temperature_{\text{In, °F}} - Temperature_{\text{Out, °F}}\right)$$

Thus:

$$Q_{\text{Btu per hour}} = 1.08 \times 18{,}000 \text{ cfm} \times 2.5 \text{ °F} = 48{,}000 \text{ Btu/hr} = .48 \text{ therms}$$

Figure 2 - Sensible Load Equation

This would likely be a conservative estimate because most of the time, unnecessary heating results in unnecessary cooling. But it would also be a fairly firm and achievable number because it was based on physical parameters associated with the observed operating condition, the equipment and the current utility rate.

As a result, some of the savings you ***suspected*** might exist based on your initial broad brush estimate are now ***known*** to exist and you gain some comfort in what the project will actually be able to deliver. You may even be able to comfortably narrow down the savings range you projected initially based on observations of this type that are made during the scoping effort.

Prioritizing Findings

The initial savings estimates may also help you prioritize your findings. For instance, upon recognizing that they had a valve leakage issue, the operating team may elect to make repairs immediately because they have a replacement valve plug in stock. Thus, you have not only firmed up the savings for your project, you have captured them!

A word of caution; if your project is part of a utility incentive program, then you will need to constrain the operating team from making the repair (which can be a bit challenging sometimes) until you establish the baseline energy consumption associated with the dysfunction. Otherwise, while you may capture the savings, you could loose the incentive payment associated with it.

Establishing Credibility

For many projects, the scoping phase is an opportunity to get to know the operating team and establish credibility. By using the field clues to develop a rough savings projection for a finding, and walking the team through your analysis while standing there

in the field, you can build credibility with the team via the demonstration of your expertise.

Bottom Line

At this point in the class, you may question your ability to do an assessment such as the one described above. But the techniques you will learn as the class progresses – with practice - will give you that capability. The point here is that once you understand how to do this, taking some time during scoping to develop an initial savings assessment can be a very desirable step to take.

Why Should I Think Ahead to the Datalogging and Functional Testing Phase During the Scoping Phase?

The scoping phase of a project is primarily about making a big picture assessment of the EBCx issues and opportunities that exist in a facility. Significant effort will be expended subsequently to investigate and develop the targeted opportunities via data logging, trend analysis and functional testing. The training course will have multiple webinars focused on the details behind these topics, including how to develop a monitoring and test plan.

However, focusing a little time and energy on considering what will be required to *perform* data logging and functional testing during the scoping phase can streamline the subsequent effort and potentially save you some frustration down the road.

Thinking Ahead about Datalogging

Establishing a baseline is a requirement for most EBCx projects, especially if a utility incentive program is involved. The details of developing a monitoring plan are a topic that will be covered in a future webinar.

But as you gain experience, you may find it valuable to bring a small assortment of basic data loggers with you when you go to scope a facility so you can strategically deploy them to start the baseline process sooner rather than later. This can be particularly important for energy saving projections, especially for variable flow systems.

More specifically, functional tests typically provide a snapshot of what is going on at a particular instance in time. For example, a pump test can be used to tell you how much power a pump is using at the time you test it.

But energy is power applied over time and to assess how much energy the pump uses over the course of a year, you will need to have some idea regarding how the power consumption you measured in your test varies over time. There are a number of ways to accomplish this; motor amperage is a common example.

Most of the time, you do not need a year of data to make the projection. Rather, you can use representative data for a period of weeks or months, correlate the data with a primary driver like climate, or occupancy or production, and then use a regression to project what the consumption might be over the period of a year.

All of these topics and the related techniques will be discussed in depth in the webinar sessions on data logging, trend analysis and energy calculations.

The point here is that assessing performance over time takes time. So, getting a head start on the process while you are in the field scoping the facility is generally a good plan. The wrong time to realize and begin to capture data for the flow profile you need when you go to complete your final report with a due date that is one week out.

Leveraging the Building Control System

Using the trending capabilities of the building's control system can be an alternative approach to using stand-alone data loggers. But there are a number of issues that can come up including.

- The points you need may not exist in the system.
- The trends you need may not exist in the system.
- The network may not be able to support the traffic rate required by the trends you need.

All of these issues can take time and perhaps budget to resolve.

The scoping phase is an excellent time explore the building control system with the operators and make an assessment of its capabilities and limitations. Armed with this information, you can:

- Identify additional opportunities. It is not uncommon when reviewing graphics to realize that things are not adding up, which generally translates to an opportunity of some sort.
- Identify data points that you will need to cover using stand along data loggers, either because they do not exist in the system or because the system cannot trend fast enough to give you meaningful data.
- Procure any specialty sensors needed for the data you want to capture.
- Budget for any costs associated with establishing trends and deploying data loggers.
- Ensure that the trends you need will be in place and running when you need them.
- Explore the possibility of remotely accessing the building control system in a read only manner to allow you to pull data and observe operations without a trip to the site.
- Ensure you have a broad enough database to establish the load and flow profile patterns you need for accurate energy consumption and savings projections when the time comes.

Thinking Ahead About Functional Testing

Functional testing will also be a topic in many of the upcoming webinars. And you will get first hand experience with it during some of the field labs included with the course.

But performing a test generally will involve applying different instruments to the systems and equipment you are focusing on, so using the scoping phase to see if test ports, traverse locations and other data access points are already in place can save you time and head-aches down the road.

For example, the ideal pump test will require that you take pressure readings at the manufacturer's gauge taps on the suction and discharge flange of the pump and ahead

of the strainer if possible to make sure that flow is not being obstructed by a dirty strainer. So:

- You would do well to check to see if the pump flange taps have been provided with service valves to allow you to hook up your meters. If not, then you will need to coordinate with the operating team to have them installed. This can take some time and recognizing the need while you are there during the scoping phase and asking the operating team to address it is much better than recognizing the need down the road on the one day you have on site to test the pump.
- Similarly, identifying a point ahead of the strainer where you can take a pressure reading at the time of the test is desirable. Unlike the pump readings, there is some flexibility regarding where you would need to take your measurement. For example, a vent at the top of the line dropping down to the pump will probably give you a pretty good sense of the entering pressure to the strainer, once you correct it for elevation and can be compared to the suction reading at the pump to assess if the strainer is dirty.
- If there happen to be gauges on the pump and ahead of the strainer, you may consider taking some readings as an informal pump test to allow you to get a sense of where the pump is running and firm up some of your savings projections. And checking the strainer pressure drop during the scoping phase may reveal a dirty strainer which will allow the operating team to clean it before you arrive to do your testing vs. having to drop everything and do it the day you arrive to test if the issue is not detected ahead of time.

Primary and Secondary Self Study Resource Details

For those who are unfamiliar with the primary resource and/or those who are interested in some secondary resources, the following are provided.

Primary Self-study Resources

Familiarity with the concepts contained in the following resources is considered essential to complement the webinar and post webinar self-study activities associated with the Scoping sessions. Note that some links will take you directly to the resource while others will take you to a page on FDE's Commissioning Resources website that contains a number of resources that will be used in the class, including the primary resources below that link to the page.

1. Chapter 5 of the Army RCx Technical Guide.
1. CERL Findings Targets List.
2. CERL ECM Targets List.
3. CERL Findings List Template.
4. Scoping Concepts Video; The video on this page covers benchmarking and utility consumption analysis – which are scoping tools – but also gets into the details of scoping starting at about the 20-minute mark. It includes the concepts of obvious indicators and findings. Note that the video includes a table of contents feature similar to what is shown in Figure 1, which will allow you to jump directly to that location.

Secondary Self-study Resources

Those interested in taking a bit of a "deeper dive" into the Scoping topic may want to consider reviewing some or all of the following resources do enhance their understanding.

1. RCx University Scoping Videos
2. A Field Guide to Engineering Blog Posts on Scoping and Findings
3. Detailed Findings List Template