

Light Water Reactor Sustainability Program

Usability Evaluation of the Innovation Portal and Integrated Capability Analysis Platform



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SUMMARY

A usability evaluation of the Integrated Capability Analysis Platform (ICAP) and Innovation Portal (IP) tools was conducted as part of the United States (U.S.) Department of Energy Light Water Reactor Sustainability (LWRS) Integrated Operations for Nuclear (ION) effort. Many nuclear operators in the U.S. are working to be more cost-competitive with subsidized renewables and natural gas by streamlining business, operations, and maintenance costs. The commercial nuclear power plant industry has looked to other industries to develop techniques, such as integrated operations, to use available technologies to reduce operations and maintenance (O&M) costs. One concept for reducing costs that has been developed is ION. A capability stack model was developed as part of the ION effort to break down information related to people, technology, processes, and governance (PTPG). The IP and ICAP tools were created from the capability stack model as part of the ION effort to help utilities reduce O&M costs by identifying work reduction opportunities.

Two LWRS program researchers completed heuristic evaluations and a cognitive walkthrough of the ICAP and IP tools to identify usability issues to further develop and improve the tools for use in the ION effort. Usability issues were identified and rated by priority levels for both tools. Overall, 4 usability issues were identified as high priority, 22 as medium, and 20 as low. The evaluators made recommendations to help address the usability issues identified in order to improve the end-user experience of using the tools once they are implemented for utilities. Future work on new interface designs for the IP tool, additional heuristic evaluations, and external testing are planned to continue refinement of the ICAP and IP tools for the ION effort.

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ACRONYMS

BCAM	Business Case Analysis Method
BCM	Business Case Model
ICAP	Integrated Operations Capability Analysis Platform
IFE	Institute for Energy Technology (Norwegian)
INL	Idaho National Laboratory
IO	Integrated Operations
ION	Integrated Operations Nuclear
IP	Innovation Portal
KPI	Key Performance Indicator
LWRS	Light Water Reactor Sustainability
NPP	Nuclear Power Plant
O&M	Operations and Maintenance
PTPG	People Technology Processes & Governance
SMEs	Subject Matter Experts

USABILITY EVALUATION OF THE INNOVATION PORTAL AND INTEGRATED CAPABILITY ANALYSIS PLATFORM

1. INTRODUCTION

The United States (U.S.) Department of Energy (DOE) Light Water Reactor Sustainability (LWRS) Program in collaboration with the Institute for Energy Technology (IFE) has worked to develop an integrated operations (IO) model for nuclear power plant (NPP) operations (Reegård, Drøivoldsmo, Rindahl, & Fernades 2014). Many nuclear operators in the U.S. are working to be more cost-competitive with subsidized renewables and natural gas by streamlining business, operations, and maintenance costs. The commercial NPP industry has looked to other industries to develop methods, such as integrated operations (IO), to use available technologies to reduce operating costs. One concept for reducing costs that has been developed is the Integrated Operations for Nuclear (ION) (Kovesdi, Thomas, Remer, Boyce 2020). ION is a transformative model that combines, integrates, and jointly optimizes the principles of people, technology, process, and governance (PTPG). By combining PTPG, businesses can identify current operations and maintenance (O&M) costs and then identify new processes and technologies that reduce those costs. The next section will look at how the ION effort was created from previous LWRS work.

1.1 What Is LWRS and ION

Many businesses have investigated ways to reduce costs in their industries using new technology. Nuclear fleet operations have run efficiently over the last few years and had one of their best overall performance years in 2019. However, rising O&M costs, along with subsidies for renewables and natural gas, have placed the commercial nuclear power fleet in a position of looking to reduce costs to be more competitive with other electricity generation options. Mining and oil and gas operations faced some of the same challenges over the last decade and have used IO to transform their businesses to help reduce costs. Using technology, many of these companies developed capabilities for remote operations of offshore drilling operations with on shore remote monitoring. However, problems have occurred in the past with industries using and implementing new technologies in their facilities with old processes. In these situations, the technology may be present but not used, or is more inefficient than the old process because the PTPG approach was not used for how the technology would be implemented. To avoid this problem, NPP's are investigating how using the ION approach to technology deployment for their operations and to realize transformative business changes.

The ION method began with research by IFE researchers in Halden, Norway and research from various industries on how technology could help reduce costs. Research on using the IO process for the North Sea oil refineries helped identify concepts that could be used in the NPP industry by identifying work functions that could be changed to reduce O&M costs. Researchers sponsored by the LWRS Program from Idaho National Laboratory (INL) have further investigated ways to use the IO method with NPP industries and apply PTPG throughout the process.

LWRS Program researchers have worked closely with an IO team from a U.S. NPP utility owner and operator to identify methods to develop effective transformative business change. Identifying capabilities of the plant is an offshoot of the IO process but is important in identifying functions critical to the mission of the NPP. When identifying plant capabilities, utilities identify goods and services that are valued internally as well as externally to their customers. Capabilities must be reusable and scalable to minimize costs. Reusable refers to the capability being generalizable and useful to the industry and scalable refers to the capability of being adaptable to work on small and simple issues, to large and complex issues.

Identifying plant capabilities will help to discover what is useful to continue and to identify areas where capabilities could be changed, such as eliminating or simplifying work functions of old processes to reduce costs. This would allow people to have better and safer jobs through identifying work functions that could be modified using new technologies.

1.1.1 Capability Stack Model and Its Use

Capability development is new to IO and has been developed to identify the PTPGs of NPP O&M activities to find areas where work reduction opportunities may occur. When using the capability stack model (Kovesdi, Thomas, Remer, Boyce 2020), it begins with using a top-down process starting on the left side by identifying plant capabilities at a high level and moving down to identify work reduction areas. By starting at the top, utilities can identify what capabilities are needed and can start to identify sub-capabilities and work functions that could have their PTPGs jointly optimized with the introduction of new technologies and a reforming of a) the work processes; b) the roles, functions, and tasks of the people; and c) how that work is governed. The model defining IO is represented in the V curve diagram of the capability stack model. Work functions are on the bottom and are usually physical plant or data systems. Identifying the work functions can help to reshape what the capabilities are in the future and identify work reduction opportunities. One factor not represented in the V curve model is the O&M cost, and if electricity and other commodities cannot be generated at the competitive market price point, the utilities would operate at a loss. Overall O&M costs can and should be identified to understand what the current costs are and identify work functions that can be changed.

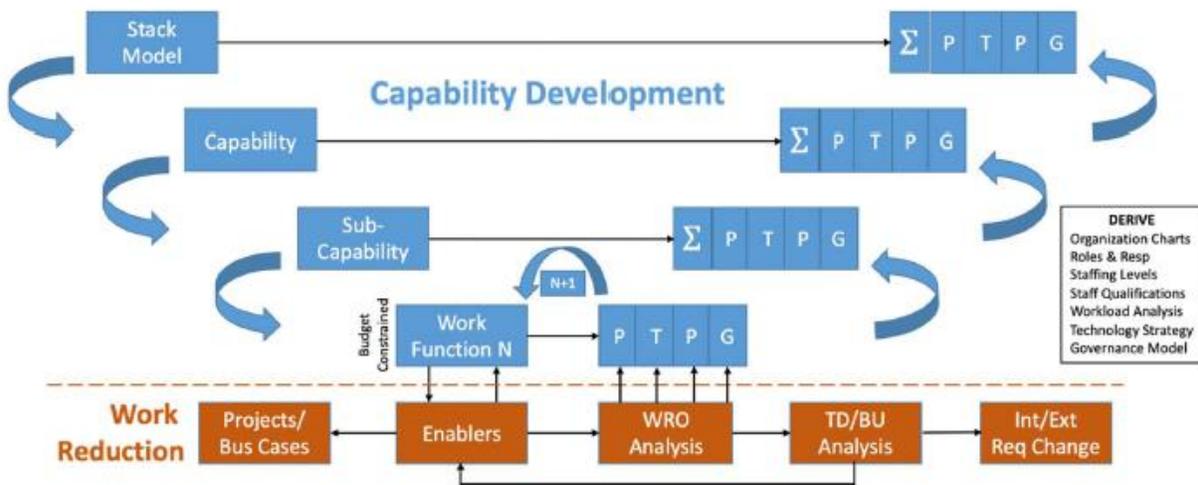


Figure 1. Capability stack model (Kovesdi, Thomas, Remer, Boyce 2020)

The right side of the capability stack model can be used for capabilities and work functions that will, or will not change, such as printer services that remain the same. Once work functions that can change are identified, the right side can be populated with how the utility will implement the new work functions. An example of a changing work function is having staff no longer take chemistry samples out in the field, when automation sensors taking samples could be installed. Staff could be assigned to different activities when work functions are changed to save costs to the utility.

1.2 What Is the ICAP and IP Their Role in ION Effort

The Integrated Operations Capability Analysis Platform (ICAP) is a software tool that has been developed by LWRS Program researchers at INL to capture the results from an IO process. The ICAP tool ensures that all work process changes, technology deployments and organizational changes have a

direct tie to achieving the future state of reduced O&M costs. It provides a quantitative basis for ensuring that the cost of performing work functions in the future can be accomplished within the allocated budget of the organization owning those work functions. It provides a means of aggregating the business cases (quantified benefits compared to investment costs) across all the work functions that will benefit from common work reduction opportunities, such as requirements changes, technology deployments, and process improvements (Kovesdi, Thomas, Remer, & Boyce 2020).

The ICAP tool is a four-way relational database that can make relationships vertically. From a bottom-up perspective, each work function goes into and is related to a sub-capability. Once the sub-capabilities are completed, they are applied to the capabilities of the plant. Budgets are set up in the organization section in the ICAP tool and are used as a bounding requirement when identifying work reduction opportunities. Each organization in the tool can have its own work function that it is responsible for, but if multiple locations have the same work reduction, they will have to be separated with a modifier.

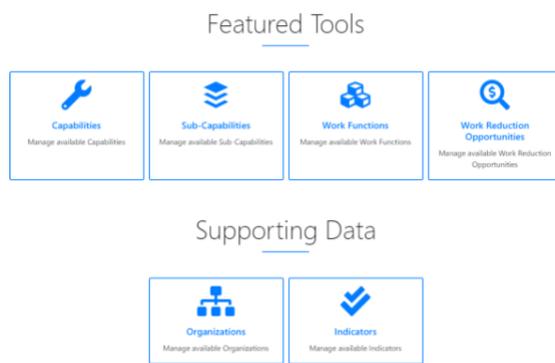


Figure 2. ICAP home page.

Figure 2 shows the capabilities section of the ICAP tool. The capabilities section has been modeled after an NPP’s current capabilities. Information can be added in this section, which is set up in different tiers, such as operate, maintain, or support the plant. Key performance indicators (KPIs) or indications used in the ICAP tool are based on an NPP’s current structure and are based on performance or diagnostics. INL’s plan is to create general KPIs that could be used if the ICAP tool is extended to other utilities for use, but utilities would also have the option of adding in their own KPIs into the tool. Once the KPIs are entered into the system, information can be added to the work functions section, as seen in Figure 3 below.

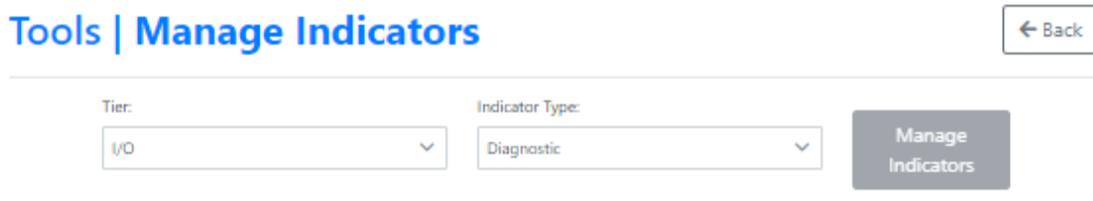


Figure 3. Image of “Manage Indicators” section for managing KPIs (Kovesdi, Thomas, Remer, Boyce 2020).

Furthermore, the Business Case Analysis Method (BCAM) software (Kovesdi, Thomas, Remer, Boyce 2020) is connected to the work reduction opportunities section, and users can add information to a spreadsheet that can be used in the BCAM software tool once the information has been added into the

ICAP tool. The ICAP tool also has a link to the Innovation Portal (IP) tool that should take the user to the corresponding section in the IP tool for work reduction opportunities.

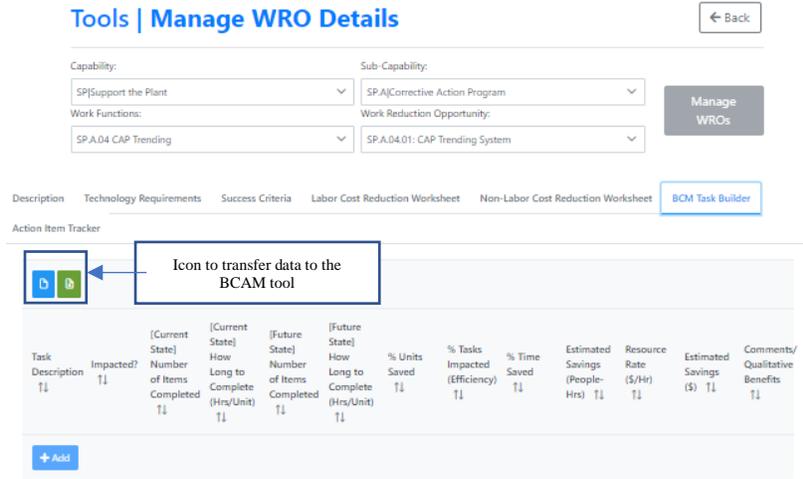


Figure 4. Image of work reduction opportunity transfer of data to the BCAM (Kovesdi, Thomas, Remer, Boyce 2020).

Currently, intended users of the ICAP tool is limited to IO professional team members that would be familiar with IO concepts. While this could be limited by having one IO team member be assigned to filling out the ICAP tool for creating a business case for work reduction opportunities, user roles and logins are expected to be expanded soon so that multiple users will be able to access the ICAP tool and enter information. We expect that this capability of having multiple members of the IO team fill in information as needed will be expanded in the future to LWRS researchers and utilities that may be interested in using the ICAP tool. If access to ICAP is expanded to utilities, users would need to be the IO professional at the plant who is familiar with the IO concepts and has the information available to add into the ICAP tool.

The ICAP tool can create a detailed report for the entire plant. It could be very time consuming if plants are required fill out the entire ICAP tool with capabilities, KPI's, and work reduction information, thereby reducing the expected return on investment value of the ICAP tool. However, if under time and resource constraints, IO professionals can look for one-off work reduction opportunities by just filling out the relevant information for ICAP certain capabilities that they believe are likely candidates for cost savings. Another solution may be to have one section of the capabilities and the organization information for one section filled out automatically in advance to save time when identifying work reduction opportunity areas. Entering information across one capability could help identify work reduction opportunities that can be used across many organizations of a utility to help reduce current budget costs. One concept that we have not added but have thought about is being able to automate information from the IP or other information from internet queries.

The IP tool was created from a 2019 LWRS workshop to identify nuclear innovation concepts. It is used as a roadmap to identify areas and technologies that could be used for work reduction opportunities. Enabling technologies, advanced capabilities, and integrated technologies are some of the areas listed in the IP. Information in each of the sections lists descriptions of the capability or technology; requirements for its use; benefits; related functional or technology areas; standards and guidance; and development level. The tool uses links to information and reports from INL and other vendors on technologies that can be used for work reduction opportunities. The IP tool can be used as a standalone tool or can be used with the ICAP tool. The ICAP tool has a link connecting to the IP tool when selecting the technologies tab in the work reduction opportunities tab.

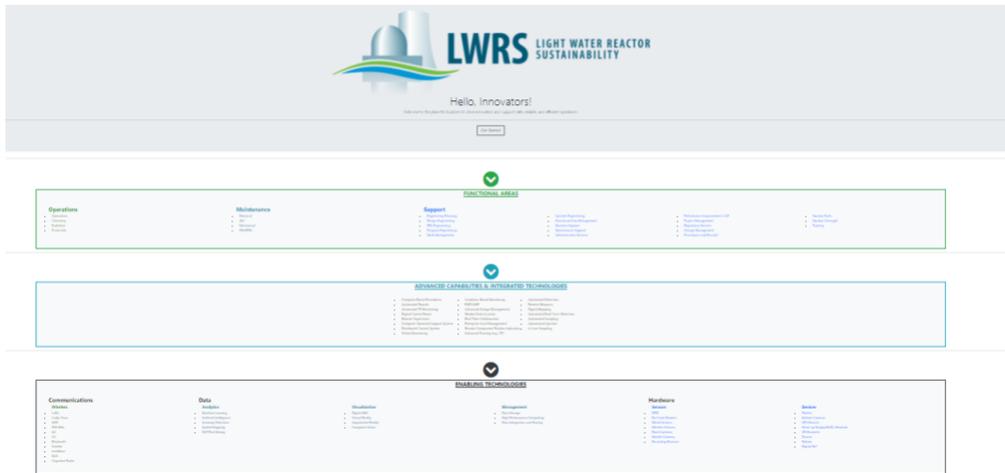


Figure 5. Home page of the IP (Kovesdi, Thomas, Remer, Boyce 2020).

1.3 Objective of Performing a Human Factors Evaluations of the ION Tools

The objective of performing human factors evaluations of the ION tools is to understand where the usability and user experience with the previously developed tools can be improved such that they will be more helpful to NPPs in their efforts to identify work reduction opportunities that can help reduce O&M costs. The ICAP and IP tools are intended to be used by NPP utilities as a means to identify work reduction opportunities. Human factors evaluation methods, including heuristic evaluations, cognitive walkthroughs, and subject matter expert (SME) interviews have been used to help identify how the ICAP and IP tools function, how users will interact with the tools, and how the tools’ functionality and the end-user’s experience can be improved.

1.3.1 How the Methods Support Human Factors Objectives

Human factors methods, such as heuristic evaluation, cognitive walkthrough, and SME interviews, were completed during the evaluation of the ICAP and IP tools. These methods were used to support and leverage the developed ICAP and IP tools by identifying how users will interact with the tool, identifying areas of concern users may encounter when using the tools, and determining the roles and tasks for the intended users of these tools. Specifically, the heuristic evaluation was used to identify usability problems and prioritize the levels of attention needed to make improvements to reduce usability errors. The cognitive walkthrough was also used to identify and prioritize usability problems; the cognitive walkthrough augmented the heuristic evaluation by providing a unique scenario-based perspective with identifying usability problems by following user stories on how the user are intended to interact with the tool. The cognitive walkthrough focused on goal-based task completion asking questions, such as what a user would expect and if they are able accomplish their goals when using the tool. Section 2 of this report provides additional detail into these methodologies. Ultimately, improving the usability and usefulness of the ICAP and IP tools will help increase user acceptance, attract more users to the tools, and further enable the ION effort through use of the tools.

2. METHODS

Usability methods, such as heuristic evaluations and cognitive walkthroughs, are used to test interface designs by identifying potential issues or problems users may encounter when interacting with a user interface. These methods are analytical in nature and involve testing design concepts using a small number of usability experts that review a design for potential usability issues. These methods are advantageous early in the development cycle as they can be completed during an initial design concept to

provide design input and estimate how user will interact with the concept and help determine what they will do and where they may encounter difficulties in the interface design.

The usability analysis methods used in this study consisted of a review of the ICAP and IP tools using common usability heuristics known as Schneiderman's Eight Golden Rules (Wong 2020) and the Nielsen Norman Group Jakob's Ten Usability Heuristics (Nielsen 2020). The cognitive walkthrough followed a streamlined set of scenario-based questioning adopted from Spencer (2002). The following sections will describe these usability methods in detail.

2.1 Heuristic Evaluation

The heuristic evaluation involved one usability expert evaluating the ICAP and IP interface using Schneiderman's Eight Golden Rules and Nielsen Norman Group Jakob's Ten Usability Heuristics. An advantage of using these heuristics early in the design phase is that they can identify potential usability problems and areas of concern without significant overhead (e.g., recruiting users) or before a mature design concept (e.g., functional prototype) is available. Because the ICAP and IP tools are still in development, we completed a review of these platforms using the heuristic evaluation to identify possible usability issues that may occur when using the tools prior to release with actual users. The usability expert used the heuristic evaluation to look for common design issues associated with underlying usability principles like consistency, recall, error prevention, help and documentation, and other potential issues when using the interface. Priority levels were added to the usability findings to identify the impact, frequency, and persistence of usability problems and the resources needed for prioritizing usability solutions, such as the following (Nielsen 1994):

- Impact—if the problem occurs, will users be able to overcome the problem
- Frequency—how often the problem occurs
- Persistence—is it a one-time problem or repeated problem for the user to overcome.

The next sections describe Schneiderman's Eight Golden Rules and Nielsen Norman Group Jakob's Ten Usability Heuristics, which were used to evaluate the IP and ICAP tools.

2.1.1 Schneiderman's Eight Golden Rules

Developed by Ben Schneiderman, eight heuristics were created based on usability principles to be applied to interactive user systems. These eight heuristics are used for creating easy-to-use interface designs, allowing for better user flow when using the product. The eight heuristics are presented as questions to help guide the usability expert to determine if the principles rules have been applied to the interface design (Figure 3).

Shneiderman's 8 Golden Rules of Interface Design

The principles	Questions to consider	Mark Complete
1. Strive for consistency	Is the style of this element maintained across your site/app? Is this content placed in the correct location according to the site hierarchy? Does this follow the conventions for your chosen platform? How can you make your designs more consistent?	<input type="checkbox"/>
2. Enable frequent users to use shortcuts	Are there shortcuts available for your more experienced users? Who is this product designed for? Will there be a need to consider experienced users? How can you make it easier and quicker for experienced users?	<input type="checkbox"/>
3. Offer informative feedback	Does the user know where they are at in the process? Does the user know what they have done after performing this action? How are you communicating this feedback to your user?	<input type="checkbox"/>
4. Design dialogue to yield closure	Does the user have to do any guessing here? Is it clear and obvious enough for your intended audience? Are there any next steps for the user? How are you communicating the system status with the user?	<input type="checkbox"/>
5. Offer simple error handling	Have you done everything imaginable to prevent this error from happening on your end? Is this error avoidable in the first place? If the user does make an error, how easy is it for them to fix it?	<input type="checkbox"/>
6. Permit easy reversal of actions	How many steps does the user have to take to reverse their actions? Will the user quickly realize they need to reverse the action in the first place? How can you make your users detect the possibility of reversal?	<input type="checkbox"/>
7. Support internal locus of control	Will the user feel in control at this specific touch point in your app? Will they be surprised in an unpleasant manner? Does the site feel easily navigable? Does the user feel safe and in control? How can you make the user feel more safe and in control?	<input type="checkbox"/>
8. Reduce short-term memory load	Are there enough visual cues here for the user to find the functionality or item? Do they have to remember things to understand what's going on? How can you help the user recall?	<input type="checkbox"/>

Figure 6. Image of Schneiderman's Eight Golden Rules (Wong 2020).

2.1.2 Nielsen Norman Jakob's 10 Usability Heuristics

This heuristic method was developed by Jakob Nielsen and was based on years of work experience in usability engineering (Langmajer 2019). This method uses 10 usability heuristics to help development teams save on development time during usability testing to help redirect attention to more complex design challenges of interface design (Langmajer 2019). The 10 Usability Heuristics are similar to Schneiderman's Eight Golden Rules, but it has been expanded to include additional heuristics, such as the aesthetic and minimalistic design and visibility of system status (Figure 4). A small number of evaluators are typically used to examine the user interface design to find potential usability issues. This method is used early in the design process to reduce usability problems. Recommendations given are a first attempt to identify potential usability issues that may halt the user from completing their task. Recommendations can be discussed with the development team for reducing potential usability concerns.

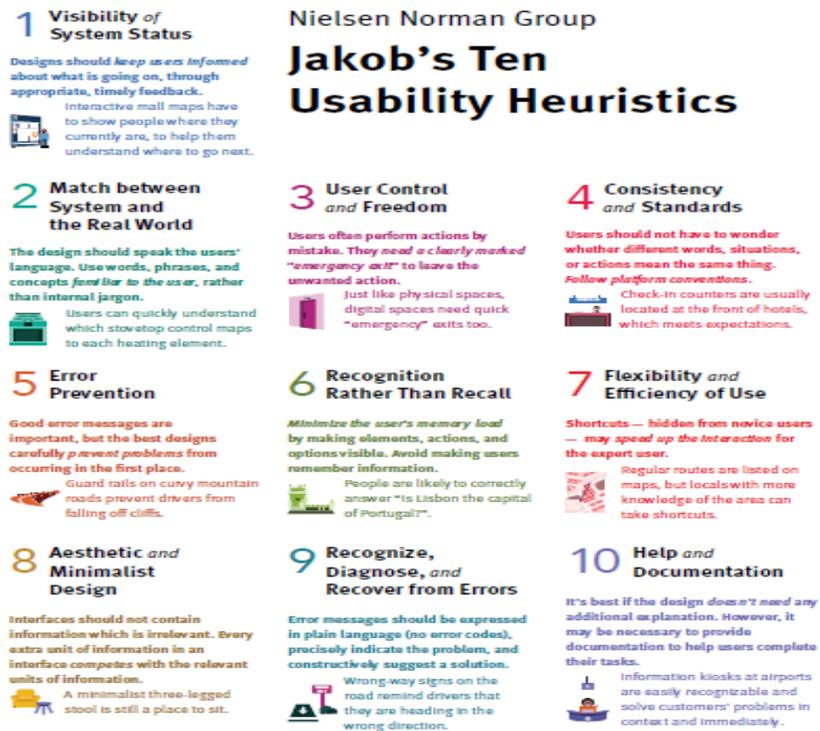


Figure 7. Nielsen Norman Group Jakob's 10 Usability Heuristics (Nielsen 2020).

2.2 Cognitive Walkthrough

A cognitive walkthrough is a usability evaluation method where an evaluator works through tasks and asks specific questions at each step from the perspective of the user during the evaluation. The cognitive walkthrough used two questions based on an article from Spencer (2000): will the user know what to do at this step and if the user does the right thing, will they know they did the right thing and are making progress towards their goal?

The cognitive walkthrough is used to understand how the system works and identify areas where new or infrequent users may encounter issues. Questions are asked during the cognitive walkthrough during the evaluation, which helps to view using the interface from the user's perspective and what their goals are using the system. User stories were developed as a part of the cognitive walkthrough with how the user would interact with the system and what their goals are during use. Creating user stories helps to find if the user can meet the objectives of the cognitive walkthrough questions.

Table 1. User story goals from cognitive walkthrough.

Tool	User Story	Description	Story Number
IP	Using the Home Page	The user's goal when accessing the IP home page have information available to them to select from various hyperlinks in the functional areas, advanced capabilities, and integrated technologies, and enabling technologies sections to find information the user is interested in.	1
IP	Using the Functional Areas Page	The goal for the user in this section is for the user to be able to select a functional area link to learn or find information about the functional areas the user is interested in.	2

Tool	User Story	Description	Story Number
IP	Using the Advanced Capabilities and Integrated Technologies Section	The user's goal for this section is to learn more about advanced capabilities and integrated technologies information for work reduction opportunities.	3
IP	Using the Enabling Technologies Section	The user's goal for this section is to learn more about enabling technologies and available vendors for off the shelf products that can be used for work reduction opportunities.	4
ICAP	Using the Home Page	The user's goal is to access the home page. They are looking for information on how to begin using the ICAP tool to develop a business case for work reduction opportunities.	5
ICAP	Using the Capability Tab	The user's goal in this section is to select from the plant capabilities list to add PTPG information into the capabilities in this top-down approach from the capability stack model. The user begins with selecting a capability from the drop-down list and if a desired capability is not present, the user can select the manage capabilities to add a capability.	6
ICAP	Using the Managing Capabilities Section	The user's goals in this section are to manage the capabilities and add new information if a capability is not available. The user's task is to begin adding information in this section to begin developing the PTPG for the capability once a capability has been selected.	7
ICAP	Using the Managing Capabilities Section	The user's goal in this section is to manage the capabilities by adding, modifying, or deleting a capability to make progress by adding, modifying, or deleting a capability. The user has to add information into the managing capability section.	8
ICAP	Using the Managing Sub-Capability Tab	The user's goal in this section the user would select from the plant capabilities list to add PTPG information into the sub-capability section to achieve their goal of completing the sub-capability section. The user begins with selecting a capability and then a sub-capability from the drop-down lists, and if a desired sub-capability is not present, the user can select manage sub-capabilities to add a new sub-capability.	9
ICAP	Using the Managing Sub-Capabilities Section	The user's goal in this section is to manage the sub-capabilities by adding, modifying, or deleting a sub-capability to make progress by adding, modifying, or deleting. The user must add information into the managing sub-capability section.	10
ICAP	Using the Managing Work Function Tab	The user's goal in the work function section can select the capabilities and sub-capabilities and the related work function to add information based on organizational and regulatory requirements related to the PTPG of the work function.	11

Tool	User Story	Description	Story Number
ICAP	Using the Manage Work Function Tab	The user's goal in this section is to manage the work functions by adding, modifying, or deleting them to make progress by adding, modifying, or deleting a capability. The user has to add information into the Managing Work Functions section. If the user wants to add information to the drop-down list, that is not available.	12
ICAP	Using the Work Reduction Opportunity Tab	The user's goal in this section is to begin to build out the Work Reduction Opportunity by providing information and technologies into the section to develop a business case for implementing a Work Reduction Opportunity in utilities.	13
ICAP	Using the Description Tab	The user goal in this section is to add a description of the work reduction opportunity and select the type of work reduction so they can begin to develop a business case for how the work reduction opportunity can be used.	14
ICAP	Using the Technology Requirements Tab	The user's goal in this section allows the user to add technologies that will help to develop a work reduction opportunity and have a link available to the IP tool to direct the user towards the enabling technology section to help identify technologies they can select.	15
ICAP	Using the Success Criteria Tab	The user's goal in this section can add related success information based on the previous information entered for work reduction opportunities after selecting the capability to be able to estimate the levels of success, risk, and difficulty levels.	16
ICAP	Using the Labor Cost Reduction Worksheet Tab	The user's goal in this section allows the user to add in labor cost reduction information to estimate the levels of success needed for saving labor O&M costs.	17
ICAP	Using the Non-Labor Cost Reduction Worksheet Tab	The user's goal for this section allows the user to add in non-labor cost reduction information to estimate the levels of success needed for saving on non-labor related O&M costs.	18
ICAP	Using the BCM Task Builder Tab	The user's goal in this section is to begin entering in information to begin the process of building the Business Case Model (BCM) by adding in required information to build out the business case for the work reduction opportunity.	19
ICAP	Using the Action Item Builder Tab	The user's goal in this section is to add information related to tracking action items to be assigned to personnel in charge of performing actions related to the work reduction opportunities.	20

Tool	User Story	Description	Story Number
ICAP	Using the Manage Work Reduction Opportunities Tab	The user's goal in the work function section can select the capabilities and sub-capabilities and the related work function to add information based on organizational and regulatory requirements related to PTPG of the work function.	21
ICAP	Using the Manage Work Reduction Opportunities Tab	The user's goal in this section is to manage the Work Reduction Opportunities by adding, modifying, or deleting Work Reduction Opportunities to make progress by adding, modifying, or deleting a Work Reduction Opportunity. The user has to add information into the managing section. If the user wants to add in information to the drop-down list, that is not available	22
ICAP	Using the Organizations Tab	The user's goal in this section is to add in related organization information to begin to populate related to their organizational level to map work functions capabilities and sub-capabilities to organizational levels.	23
ICAP	Using the Indications Tab	The user goal in this section is to manage the KPIs that are related to the capabilities and sub-capability sections for the user to connect the KPI's to the related capabilities and sub-capabilities. The user can view the KPIs in this section and also add new KPIs that are not included in the list by selecting the managing KPIs button to add or remove a KPI.	24

2.3 SME Interviews

We conducted several interviews with SMEs throughout the study to learn more about previous work completed to develop the ION model. Two of these SMEs have been working with U.S. NPPs in developing IO concepts that could be leveraged into NPP business models to help reduce O&M costs; they provided detailed information about ION. We also interviewed a software engineer SME to learn about the technical considerations with developing the ICAP and IP tools. The following sections discuss the interviews with these different experts.

2.3.1 ION SMEs

The ION SMEs that we interviewed to learn more about development of the ION effort are two engineering industry leading experts that have many years of NPP experience and are also current industry research liaisons. They have worked on the development of IO models that have led to the ION model being developed by INL. During our interview, the SMEs were asked to describe how the ION effort started with concepts from industries that have adopted IO as a part of their business models, which led to the creation of ION. The SMEs have worked closely with different NPP utilities to develop and verify how ION could be used in their plants (see Appendix C).

2.3.2 Software Engineer of the ICAP and IP Tools

We completed interviews with a software engineer that developed the ICAP and IP tools. The software engineer described how ION model concepts were developed into the ICAP and IP tools from working with SMEs that developed the ION model. The software engineer described how users would be able to access the system and also walked the researchers through the platforms to understand how the

systems will be used for the ION effort. There is ongoing work to update the ICAP tool with additional features that are currently missing at the time of the writing of this report.

2.4 Synthesizing Usability Findings

The heuristic evaluation methods have been synthesized together based on related heuristics from Schneiderman’s 8 Golden Rules, the Nielson Norman Group Jakob’s 10 Usability Heuristics, and a cognitive walkthrough to report on areas that would benefit from having additional information or details to help the efficiency of the users’ workflow when using the ICAP and IP tools. Several of the heuristics in both evaluation methods look at similar information. By synthesizing the results together to report the findings, recommendations can be made based on the convergence of usability findings.

3. USABILITY FINDINGS

The evaluation of the ICAP and IP tools was completed using usability methods that focused on the user’s flow through the tools. Each of the methods focused how the users would interact with the tools and identified areas where they may encounter issues that would halt progress during use of the tools. Further details from the usability methods will be discussed in the following sections.

3.1 Findings from Heuristic Evaluations

Usability findings from the heuristic evaluation methods (Schneiderman’s 8 Golden Rules and the Nielson Norman Group 10 Usability Heuristics) are discussed in further detail below. Findings for the IP are in Section 3.1.1, and findings for the ICAP tool are in Section 3.1.2. See Appendix A for a detailed review of the heuristic evaluation findings.

Table 2. Overall evaluation of heuristic evaluation findings.

Overall Heuristic Evaluation Priority Findings			
Tool	High	Medium	Low
ICAP	2	10	9
Innovation Portal (IP)	3	1	1

3.1.1 Innovation Portal (IP) Findings

The IP tool heuristic evaluation was completed on the different sections that the user accesses in the tool to identify information that they are interested in learning about. The following sections of the IP tool and their associated findings are summarized below.

Table 3. IP findings table.

Issues	Heuristics	Priority (number of pages)	Application of Issue Located
When scaling the IP home page, the labels on the home page can become garbled and reduce readability.	Aesthetic and Minimalist Design	Low	<ul style="list-style-type: none"> Home Page
Linked and non-linked text are colored black on the pages, making it difficult to distinguish between linked and non-linked information without memorization.	Consistency and Standards Recognition Rather Than Recall	High (3)	<ul style="list-style-type: none"> Functional Areas Page Advanced Capabilities and Integrated Technologies Page Enabling Technologies Page

Issues	Heuristics	Priority (number of pages)	Application of Issue Located
Links in the home page are not alphabetized leading to increase search time to locate information.	Consistency and Standards	Medium	<ul style="list-style-type: none"> Home Page

3.1.1.1 Home Page

There were two usability issues identified. The first issue is that the links on the home page are not alphabetized, leading to an increase in search time to locate information. The heuristic principle Consistency and Standards was not followed in the design. A medium priority was assigned to this task to reduce the search time when locating information.

The next issue on the home page was that, when scaling the IP home page, the labels on the home page can become garbled and reduce readability. The heuristic principle Aesthetic and Minimalist Design was not followed. A low priority was assigned to this task because it can affect readability when the tool is rescaled.

3.1.1.2 Functional Areas Section

There was one usability issue identified. The issue is that linked and non-linked text are colored black on the pages, making it difficult to distinguish between information without memorization. The heuristic principles Consistency and Standards and Recognition Rather than Recall were not followed in the design. A high priority was assigned to this task because it is difficult to distinguish between the linked and non-linked text. An illustration of this is shown in Figure 8.



Figure 8. Image from the IP Functional Areas (Kovesdi, Thomas, Remer, Boyce 2020).

3.1.1.3 Advanced Capabilities and Integrated Technologies Section

There was one usability issue identified. The issue is that linked and non-linked text are colored black on the pages making it difficult to distinguish between information without memorization. The heuristic principles Consistency and Standards and Recognition Rather than Recall were not followed in the design. A high priority was assigned to this task because it is difficult to distinguish between the linked and non-linked text. An illustration of this is shown in Figure 9.

Description:
 Work instructions will be consistent across all organizations and will be streamlined to provide only task-relevant and condition-relevant instructions to the user. Work instructions will be presented on a mobile device and users will have real-time access to supporting information, just-in-time-training, and communication tools. Conditions encountered in the field will be documented with rich media and information will be updated in real-time to all relevant systems. Control room operators and decision makers will have real-time awareness of conditions in the field and better understanding of plant status.

Requirements/Benefits:

- **Remote monitoring of status (plant, equipment, procedure)**
 - Less time waiting
 - More precise scheduling
- **Automatic verification (correct component, worker qualifications, plant conditions)**
 - Fewer corrective actions
 - More efficient procedure execution
- **Real-time communication**
 - Improved communication
 - Less time waiting
 - More efficient procedure execution
- **Automatic updating (plant, equipment, record keeping)**
 - Better tracking of plant status
 - Fewer procedural conflicts
 - More efficient record keeping for compliance
- **Automatic tracking of administrative tasks (placekeeping, signoffs)**
 - More robust record keeping
 - More efficient procedure execution
- **Automatic processing of field data (calculations, checking tech specs, limits, thresholds)**
 - Fewer human errors
 - Fewer corrective actions
 - More robust record keeping
- **Dynamic/Context-sensitive instructions**
 - Fewer human errors
 - Reduced time managing procedures
- **Capture of media in the field**
 - Better transfer of knowledge
 - Improved decision making
 - Faster resolution of emerging issues
 - Fewer human errors
- **Appealing user interface**
 - Recruitment and retention of skilled workforce

Available Products: Related Enabling Technologies: Demonstrated Resources:

Figure 9. Image from the IP Advanced Capabilities and Integrated Technologies section (Kovesdi, Thomas, Remer, Boyce 2020).

3.1.1.4 Enabling Technologies Section

There was one usability issue identified. The issue is that linked and non-linked text is colored black on the pages, making it difficult to distinguish between information without memorization. The heuristic principles Consistency and Standards and Recognition Rather than Recall were not followed in the design. A high priority was assigned to this task because it is difficult to distinguish between the linked and non-linked text. An illustration of this is shown in Figure 10.

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Description:
 Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.

Applicable Advanced Capabilities/Integrated Technologies:

Available Vendors:

Utilities who have implemented or will implement the technology:

- [util1](#)
- [util2](#)
- [util3](#)

Applicable Guidelines and Standards for Technology Implementation:

[Regulatory Standards](#)

[NRC Guidance](#)

[ISO Guidance](#)

[EPRI Guidance](#)

Implementation Suggestions:

Associated Media:

[Launch Media](#)

Figure 10. Enabling Technologies section (Kovesdi, Thomas, Remer, Boyce 2020).

3.1.2 Integrated Operations Capability Analysis Platform (ICAP) Findings

The ICAP tool heuristic evaluation was completed on each individual section that the user accesses to identify information that they are interested in learning about. The following ICAP sections and their associated findings are summarized below.

Table 4. Heuristic evaluation of ICAP findings

Issue	Heuristics	Priority	Application of Issue
<p>Unclear where to start beginning ICAP process based on current design. There are multiple ways to access ION layers, but there is no explicit instructions specifying how these layers fit together and where to first start. Formal training is needed.</p>	<p>Match Between the System and the Real World</p>	<p>Low</p>	<ul style="list-style-type: none"> • Home Page
<p>Error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data.</p>	<p>Recognize, Diagnose, and Recover from Errors</p>	<p>High (2)</p>	<ul style="list-style-type: none"> • Manage Indicators Tab • Capability Tab
<p>When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting “Delete.” This one-click action may create inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button.</p>	<p>Error Prevention</p>	<p>Medium (4)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities
<p>Adding a new capability, sub-capability, work function, or work reduction opportunity is not explicitly intuitive. The design is a gray button to the right that will populate the database that feeds the drop-down menus per page. The association between this manage button and data may not be intuitive to new users.</p>	<p>Consistency and Standards</p>	<p>Low (4)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities
<p>The fields that are provided on the labor, non-labor, BCM tabs, and Action tracker tabs are technical in nature, specific to ION or NPP convention, and do not currently have explicit descriptions of what each fields are from the ICAP. The fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity.</p>	<p>Help and Documentation</p>	<p>Medium (6)</p>	<ul style="list-style-type: none"> • Success Criteria Tab • Labor Cost Reduction Worksheet Tab • Non-Labor Cost Reduction Worksheet Tab • BCM Task Builder Tab • Action Item Tracker Tab • Manage Indicators Tab

Issue	Heuristics	Priority	Application of Issue
<p>Currently, the user guide information text only states to select a work function and a related work reduction opportunity and does not state that a capability and a sub-capability need to be selected.</p> <p>User guide information text only states to select a work function and a related work reduction opportunity and does not state that a capability and a sub-capability need to be selected even though other boxes to be selected are present.</p>	Help and Documentation	Low (3)	<ul style="list-style-type: none"> • Work Reduction Opportunity Tab • Work Function Tab • Description Tab
<p>Icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These icons do not have an explicit label and may not be intuitive to users who are new to the ICAP.</p>	Recognition rather than Recall	Low	<ul style="list-style-type: none"> • Technology Requirements Tab

3.1.2.1 Home page

There was one usability issue identified. The issue was information directing the user on how to begin using the interface is not available on the home page and formal training may be required to use the tool. The heuristic principle Match between the System and the Real World was not followed. A low priority was assigned to add instructions to help guide the user on where to begin using the ICAP tool.

3.1.2.2 Capability tab

There was one usability issue identified. The issue was that error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data. The heuristic principle Recognize, Diagnose, and Recover from Errors was not followed. A high priority was assigned to prevent error messages from occurring that do not inform the user of the cause.

Managing Capabilities Section

There were two usability issues identified. The first issue was when managing capabilities, a user can delete data by selecting the delete button with a one inadvertent click causing the user to lose all of the entered information due to the proximity of the save and delete buttons. The heuristic principle Error Prevention was not followed. A medium priority was assigned to prevent the deletion of information entered by the user from an inadvertent click. An illustration of this is shown in Figure 11 in the bottom right corner of the illustration.

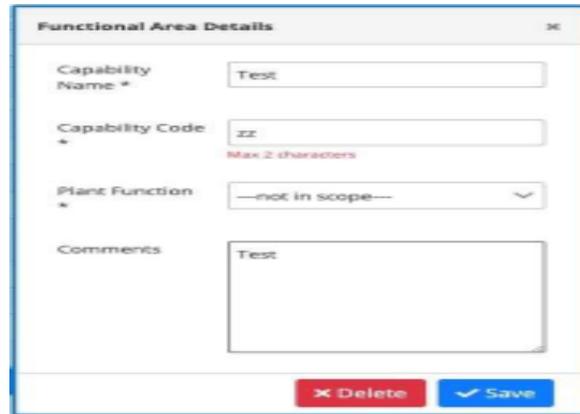


Figure 11. Managing capabilities (Kovesdi, Thomas, Remer, Boyce 2020).

The second issue was the design of a gray button is used next to the select capability section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a capability. The heuristic principle Consistency and Standards was not followed. A low priority was assigned to make the association of the data and the manage button more intuitive to users. An illustration of this is shown in Figure 12.

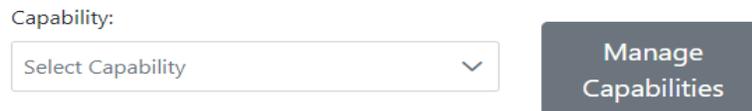


Figure 12. ICAP selecting a capability (Kovesdi, Thomas, Remer, Boyce 2020).

3.1.2.3 *Sub-capability Tab*

Managing Sub-Capabilities Section

There were two usability issues identified. The issue was that, when managing sub-capabilities, a user can delete data by selecting the delete button with a one inadvertent click causing the user to lose all of the entered information due to the proximity of the save and delete buttons. The heuristic principle Error Prevention was not followed. A medium priority was assigned to prevent the deletion of information entered by the user from an inadvertent click.

The second issue was that the design of a gray button used next to the select sub-capability section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a sub-capability. The heuristic principle Consistency and Standards was not followed. A low priority was assigned to make the association of the data and the manage button more intuitive to users.

3.1.2.4 *Work Function Tab*

Managing Work Functions

There were two usability issues identified. The first issue was that, when managing work functions, a user can delete data by selecting the delete button with a one inadvertent click causing the user to lose all of the entered information due to the proximity of the save and delete buttons. The heuristic principle Error Prevention was not followed. A medium priority was assigned to prevent the deletion of information entered by the user from an inadvertent click. An illustration of this is shown in Figure 13 in the bottom right corner of the illustration.

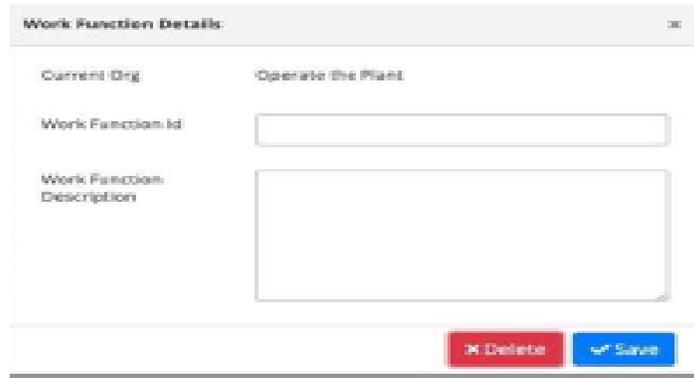


Figure 13. Managing work functions (Kovesdi, Thomas, Remer, Boyce 2020).

The second issue was the design of a gray button is used next to the select work functions section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a Work Function. The heuristic principle Consistency and Standards was not followed. A low priority was assigned to make the association of the data and the manage button more intuitive to users.

3.1.2.5 Work Opportunity Reductions Tab

There was one usability issue identified. The issue was that the user guide information text only states to select a work function and a related work reduction opportunity and does not state that a capability and sub-capability need to be selected even though other boxes to be selected are present. The heuristic principle Help and Documentation was not followed. A low priority was assigned to this section to add additional help and documentation to guide the user on how to add information in the work reduction opportunity section. An illustration of this is shown in Figure 14.



Figure 14. Selecting a Work Reduction Opportunity (Kovesdi, Thomas, Remer, Boyce 2020).

Description Tab

There was one usability issue identified. The issue was to help the user understand how the Work Reduction Type drop-down menu is used and what type of information is needed to be entered into the description. Newer users may not understand what type of information is needed to be entered into the description area and the related work reduction type drop-down menu. The heuristic principle Help and Documentation was applicable but not followed. A low priority rating was given for this section to add help and documentation to guide the user on what information needs to be added in this section and what the drop-down work reduction type box is used for. An illustration of this is shown in Figure 15.

Figure 15. Description Tab section (Kovesdi, Thomas, Remer, Boyce 2020).

Technology Requirements Tab

There was one usability issue identified. The issue was that icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These icons do not have an explicit label and may not be intuitive to users who are new to the ICAP. The heuristic principle Recognition Rather than Recall was not followed. A low priority was assigned because the icons can be made to be more intuitive to newer ICAP users. An illustration of this is shown in Figure 16.

Figure 16. Technology Requirements section (Kovesdi, Thomas, Remer, Boyce 2020).

Success Criteria Tab

There was one usability issue identified. The issue was that fields in this section are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. A medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section. An illustration is shown in Figure 17.

Figure 17. Success Criteria section (Kovesdi, Thomas, Remer, Boyce 2020).

Labor Cost Reduction Worksheet Tab

There was one usability issue identified. The issue was that the fields that are provided on the Labor Cost Reduction Worksheet tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each fields are from the ICAP. The heuristic principle Help and Documentation was not followed. A medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section. An illustration is shown in Figure 18.

Figure 18. Labor Cost Reduction Worksheet (Kovesdi, Thomas, Remer, Boyce 2020).

Non-Labor Cost Reduction Worksheet Tab

There was one usability issue identified. The issue was that the fields that are provided on the Non-Labor Cost Reduction Worksheet tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each fields are from the ICAP. The heuristic principle Help and Documentation was not followed. A medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section. An illustration is shown in Figure 19.

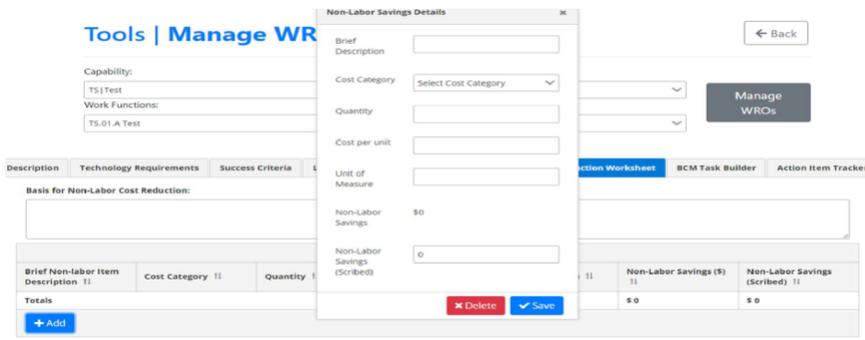


Figure 19. Non-Labor Cost Reduction Worksheet (Kovesdi, Thomas, Remer, Boyce 2020).

BCM Task Builder Tab

There was one usability issue identified. The issue was that the fields provided on the BCM Task Builder tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is used for in the ICAP. The heuristic principle Help and Documentation was not followed. A medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section. An illustration is shown in Figure 20.

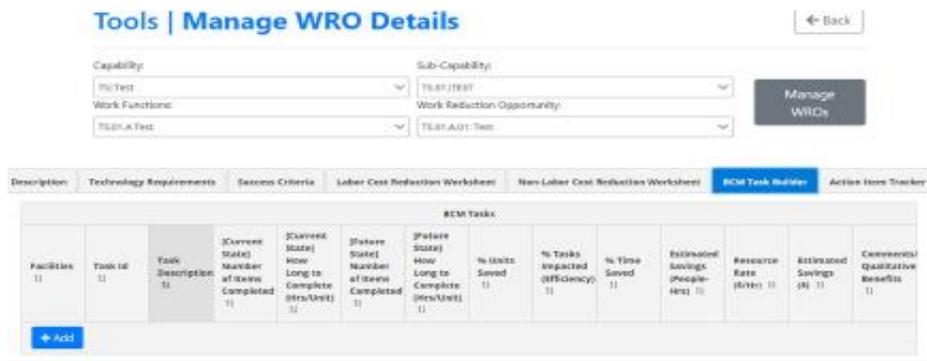


Figure 20. BCM Task Builder section (Kovesdi, Thomas, Remer, Boyce 2020).

Action Item Tracker Tab

There was one usability issue identified. The issue was that the fields provided on the Action Item Tracker tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is used for in the ICAP. The heuristic principle Help and Documentation was not followed. A medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section. An illustration is shown in Figure 21.

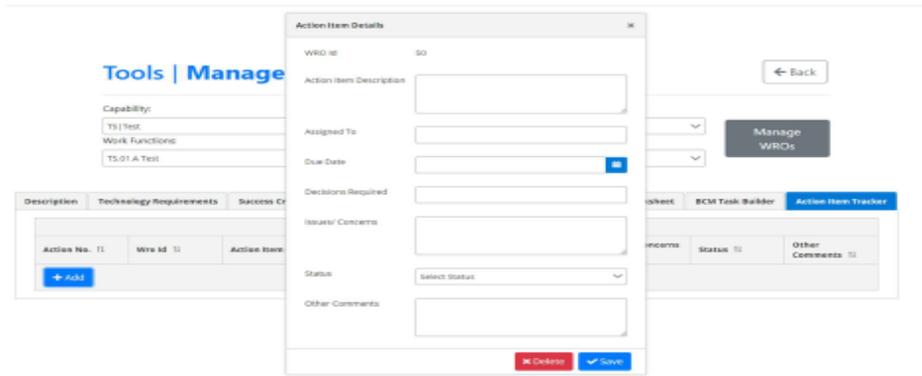


Figure 21. Action Item Tracker section (Kovesdi, Thomas, Remer, Boyce 2020).

Manage Work Reduction Opportunities Tab

There was one usability issue identified. The issue was that, when managing Work Reduction Opportunities, a user can delete data by selecting the delete button with a one inadvertent click causing the user to lose all of the entered information due to the proximity of the save and delete buttons. The heuristic principle Error Prevention was not followed. A medium priority was assigned to prevent the deletion of information entered by the user from an inadvertent click.

3.1.2.6 Organizations Tab

There was one usability issue identified. The issue was that the fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity. The heuristic principle Help and Documentation was not followed. A medium priority was assigned due to the need for additional help and documentation for the user to accurately populate the fields. An illustration of this is shown in Figure 22.

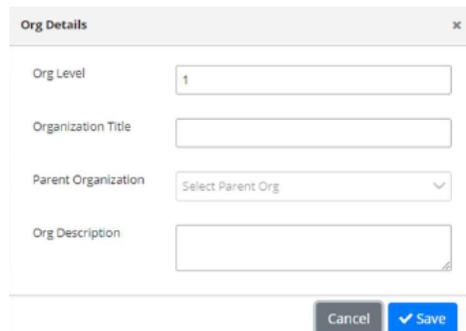


Figure 22. Managing Organizations section (Kovesdi, Thomas, Remer, Boyce 2020).

3.1.2.7 Indications Tab

There was one usability issue identified. The issue was that error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data. The heuristic principle Recognize, Diagnose, and Recover from Errors was not followed. A high priority was assigned to show users the cause of the error messages to prevent them from occurring. An illustration of this is shown in Figure 23.

Figure 23. Managing Indicators section (Kovesdi, Thomas, Remer, Boyce 2020).

3.2 Findings from the Cognitive Walkthrough

We performed the cognitive walkthrough on the IP and ICAP tools. This method was performed from a new user’s perspective when interacting with the tools for the first time and completing tasks. The ICAP generally uses a top-down approach for entering information; however, a bottom-up approach for entering information into the ICAP has been added into the findings. Findings for the IP are reported in Section 3.2.1, and findings for the ICAP tool are in Section 3.2.2.

Table 5. Overall evaluation of heuristic evaluation findings.

Overall Cognitive Walkthrough Priority Findings			
Tool	High	Medium	Low
ICAP	2	10	9
Innovation Portal (IP)	3	1	1

3.2.1 Innovation Portal (IP) Findings

The cognitive walkthrough results have been separated in the report sections below by related areas based on the user flow when using the IP tool.

Table 6. IP findings from cognitive walkthrough.

Issues	User Story Identified	Priority (number of pages)	Application of Issue Located
When scaling the IP home page, the labels on the home page can become garbled and reduce readability.	1	Low	<ul style="list-style-type: none"> Home Page
Linked and non-linked text is colored black on the pages, making it difficult to distinguish between linked and non-linked information without memorization.	2, 3, 4	High (3)	<ul style="list-style-type: none"> Functional Areas Page Advanced Capabilities and Integrated Technologies Page Enabling Technologies Page
Links on the home page are not alphabetized leading to increase search time to locate information.	1	Medium	<ul style="list-style-type: none"> Home Page

3.2.1.1 Home Page

There were two usability issues identified. The first issue is that the links on the home page are not alphabetized, leading to an increase in search time to locate information. This issue was identified in User Story 1 and assigned a low priority for making improvements to help users locate information more efficiently and reduce search time.

The second issue was when resizing the browser window some information is garbled and lost due to scaling and has been rated a high priority to fix the readability issues from occurring. This issue was identified in User Story 1 and assigned a low priority to prevent readability issues from occurring.

3.2.1.2 Functional Areas Section

There was one usability issue identified. The issue was that the black text is the same for linked and non-linked text. Users would have to remember what information has linked and non-linked information. The issue was identified in User Story 2 and was assigned a high priority to adjust the text so users can tell the difference between linked and non-linked information.

3.2.1.3 Advanced Capabilities and Integrated Technologies Section

There was one usability issue identified. The issue was usability issues found in this section were that the black text is the same for linked and non-linked text. Users would have to remember what information has linked and non-linked information. The issue was identified in User Story 2 and was assigned a high priority to adjust the text so users can tell the difference between linked and non-linked information.

3.2.1.4 Enabling Technologies Section

There was one usability issue identified. The issue was that the black text is the same for linked and non-linked text. Users would have to remember what information has linked and non-linked information. The issue was identified in User Story 2 and was assigned a high priority to adjust the text so users can tell the difference between linked and non-linked information.

3.2.2 Integrated Operations Capability Analysis Platform (ICAP) Findings

The cognitive walkthrough results have been separated into related areas based on the user flow when using the ICAP tool, and the findings are summarized in the report sections below. A common theme was identified that newer users would not be able to make progress when using the ICAP tool if they were not familiar with IO concepts or trained on the ICAP. The cognitive walkthrough will focus on user goals and usability issues encountered when the user has been trained on how to use the ICAP tool.

If users decide to start with the Capability section when using the ICAP, they will be using the top-down approach as referenced in the capability stack model in Figure 1. Users may decide that they would like to enter information in a different way by starting at lower layers of the capability stack model. Top-down to bottom-up approaches will be discussed further in the below section on how they can be applied when using the ICAP tool.

Table 7. ICAP findings from cognitive walkthrough.

Issue	Identified In	Priority	Application of Issue
Unclear where to start beginning ICAP process based on current design. There are multiple ways to access ION layers, but there is no explicit instructions specifying how these layers fit together and where to first start. Formal training is needed.	User Story 5	Low	<ul style="list-style-type: none"> Home Page

Issue	Identified In	Priority	Application of Issue
<p>Error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data.</p>	<p>User Story 6, 23</p>	<p>High (2)</p>	<ul style="list-style-type: none"> • Manage Indicators Tab • Capability Tab
<p>When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting “Delete.” This one-click action may create inadvertent deletion and the user would lose everything entered. Further, the delete button is located right next to the save button.</p>	<p>User Story 7, 9, 11, 21</p>	<p>Medium (4)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities
<p>Adding a new capability, sub-capability, work function, or work reduction opportunity is not explicitly intuitive. The design is a gray button to the right that will populate the database that feeds the drop-down menus per page. The association between this manage button and data may not be intuitive to new users.</p>	<p>User Story 8, 10, 12, 22</p>	<p>Low (4)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities
<p>The fields that are provided on the labor, non-labor, BCM tabs, and Action Tracker tabs are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each fields are from the ICAP.</p> <p>The fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity.</p>	<p>User Story 16, 17, 18, 19, 20, 23, 24</p>	<p>Medium (6)</p>	<ul style="list-style-type: none"> • Success Criteria Tab • Labor Cost Reduction Worksheet Tab • Non-Labor Cost Reduction Worksheet Tab • BCM Task Builder Tab • Action Item Tracker Tab • Manage Indicators Tab
<p>Icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These icons do not have an explicit label and may not be intuitive to users who are new to the ICAP.</p>	<p>User Story 15</p>	<p>Low</p>	<ul style="list-style-type: none"> • Technology Requirements Tab

Issue	Identified In	Priority	Application of Issue
<p>Currently, the user guide information text only states to select a work function and a related work reduction opportunity and does not state that a capability and a sub-capability need to be selected</p> <p>User guide information text only states to select a work function and a related work reduction opportunity and does not state that a capability and a sub-capability need to be selected even though other boxes to be selected are present</p>	User Story 13, 14	Low (3)	<ul style="list-style-type: none"> • Work Reduction Opportunity Tab • Work Function Managing Tab • Description Tab

3.2.2.1 Home Page

There was one usability issue identified. The issue was that limited information is available to users on how to begin using the tool, which may not help the user achieve their goal of learning how to navigate through the IP tool. The issue was identified in User Story 5 and was assigned a medium priority to add more information for users on how to begin using the tool and where to begin adding in information.

3.2.2.2 Capability Tab

There was one usability issue identified. The issue was that error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors. The issue was identified in User Story 6 and was assigned a medium priority to inform the user on why the error messages occurred and how to prevent errors.

Managing Capabilities

There were two usability issues identified. The first issue was that, when adding a new capability, a user can delete data entered by selecting “Delete.” This one-click action may create an inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button. This issue was identified in User Story 7 and was assigned a medium priority level to prevent the deletion of information entered by the user from an inadvertent click.

The second issue was that the design of a gray button used next to the select capability section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a capability. The issue was identified in User Story 8 and was assigned a low priority to make the association of the data and the manage button more intuitive to users.

3.2.2.3 Sub-Capability Tab

Managing Sub-Capabilities

There were two usability issues identified. The first issue was that, when adding a new sub-capability, a user can delete data entered by selecting “Delete.” This one-click action may create an inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button. This issue was identified in User Story 9 and was assigned a medium priority level to prevent the deletion of information entered by the user from an inadvertent click.

The second issue was that the design of a gray button used next to the select sub-capability section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a sub-capability. The issue was identified in User

Story 10 and was assigned a low priority to make the association of the data and manage button more intuitive to users.

3.2.2.4 Work Function Tab

Managing Work Functions

There were two usability issues identified. The first issue was that, when adding a new work function, a user can delete data entered by selecting “Delete.” This one-click action may create an inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button. This issue was identified in User Story 11 and was assigned a medium priority level to prevent the deletion of information entered by the user from an inadvertent click.

The second issue was the design of a gray button is used next to the select Work Function section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a work function. The issue was identified in User Story 12 and was assigned a low priority to make the association of the data and the manage button more intuitive to users.

3.2.2.5 Work Reduction Opportunity Tab

Description Tab

There was one usability issue identified. The issue was a description and work reduction type information needed in the section, but there is no guidance for the user to understand what the work reduction type drop-down box is used for and is not intuitive. The issue was identified in User Story 14 and was assigned a low priority to add help and documentation to guide the user on what information needs to be added in this section and what the drop-down work reduction type box is used for.

Technology Requirements Tab

There was one usability issue identified. The issue was that icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These icons do not have an explicit label and may not be intuitive to users who are new to the ICAP. The issue was identified in User Story 15 and was assigned a low priority to make the icons more intuitive to new users.

Success Criteria Tab

There was one usability issue identified. The issue was the fields that are provided on the Success Criteria tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. The issue was identified in User Story 16 and was assigned a medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section.

Labor Cost Reduction Worksheet Tab

There was one usability issue identified. The issue was the fields that are provided on the Labor Cost Reduction Worksheet tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. The issue was identified in User Story 17 and was assigned a medium priority because more help and documentation are needed to guide the user on how to complete this section.

Non-Labor Cost Reduction Worksheet Tab

There was one usability issue identified. The issue was the fields that provided on the Non-Labor Cost Reduction Worksheet tab are technical in nature, specific to ION, and/or NPP convention and do not

currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. The issue was identified in User Story 18 and was assigned a medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section.

BCM Task Builder Tab

There was one usability issue identified. The issue was the fields that are provided on the BCM Task Builder Tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. The issue was identified in User Story 19 and was assigned a medium priority was given to this section because more help and documentation are needed to guide the user on how to complete this section.

Action Item Tracker Tab

There was one usability issue identified. The issue was the fields that are provided on the Action Item Tracker Tab are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each field is from the ICAP. The heuristic principle Help and Documentation was not followed. The issue was identified in User Story 20 and was assigned a medium priority because more help and documentation are needed to guide the user on how to complete this section.

Manage Work Reduction Opportunities Tab

There were two usability issues identified. The first issue was when adding a new Work Reduction Opportunity, a user can delete data entered by selecting “Delete.” This one-click action may create an inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button. This issue was identified in User Story 21 and was assigned a medium priority level to prevent the deletion of information entered by the user from an inadvertent click.

The second issue was that the design of a gray button used next to the select Work Reduction Opportunity section on the right is not explicitly intuitive to the user. The button is used to populate the database that will feed information into the drop-down menu for selecting a Work Reduction Opportunity. The issue was identified in User Story 22 and was assigned a low priority to make the association of the data and the manage button more intuitive to users.

3.2.2.6 Organizations Tab

There was one usability issue identified. The issue was that the fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity. The issue was identified in User Story 23 and was assigned a medium priority level due to the need for additional help and documentation for the user to accurately populate the fields.

3.2.2.7 Indications Tab

There was one usability issue identified. The issue was that error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data. The issue was identified in User Story 24 and was assigned a high priority to show users what the cause of the error messages to prevent them from occurring.

3.3 Interviews with SMEs

During interviews with SMEs, more information was provided to learn how the ION model was created and the process of development of the IP and ICAP tools. SMEs talked about their work with NPP utilities and how they have been developing a methodology to create the ION case business models. The

capability stack model was discussed with respect to how it is used by utilities and how the information from the model was used to develop the ICAP tool. SMEs mentioned that the current ICAP tool was originally developed as an access database and some of the features are not currently present, such as the budgeting information. SMEs said that they are currently working with a developer to add additional features that are not in the current version.

3.4 Interview with Software Engineer

The software engineer described how he developed the ICAP and IP tools from the access database and working with the SMEs developing the ION effort. The software engineer talked about how the ICAP was developed from the access database into its current web-based format. Currently, the developer is working on the user access system to provide individual user access to the ICAP tool. The developer said that the system is still being worked on but is about 90% complete at this time.

4. RECOMMENDATIONS FROM SYNTHESIZED USABILITY FINDINGS

Six high priority recommendations were found in the IP tool and while high (n=4) were found in the ICAP tool. The majority of the heuristic evaluation priority findings were categorized in the low (n = 20) or medium priority (n = 22) of possible usability issues in the ICAP and IP tools. Medium priority issues identified were related to consistency, error handling, help, and documentation from the heuristic evaluations and the same issues were identified during the cognitive walkthrough. Providing additional information, such as text explaining what some of the functions are or how to use the functions would help to decrease usability errors for new users. Maintaining consistency across the platforms will allow for the user to understand the tool clearly without having to stop due to changes in how the tool is used.

4.1 ICAP Recommendations

The following recommendations from the cognitive walkthrough and heuristic evaluation address the usability issues found in the following sections of the ICAP tool.

Table 8. ICAP recommendations.

Issue	Priority	Location	Recommendations
Unclear where to start beginning ICAP process based on current design. There are multiple ways to access ION layers, but there is no explicit instructions specifying how these layers fit together and where to first star. Formal training is needed.	Low (2)	<ul style="list-style-type: none"> Home Page User Story 5 	Recommendation to add help and documentation to the home page to help guide early users on how to begin using the ICAP tool.
Error messages appear when using the drop-down boxes in a reactive manner as opposed to showing what is causing these errors. The user has all available options in the lookup table available via dropdowns, but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data.	High (4)	<ul style="list-style-type: none"> Manage Indicators Tab Capability Tab User Stories 6, 23 	Recommend graying out the drop-down boxes when no data is available to prevent error messages from occurring.

Issue	Priority	Location	Recommendations
<p>When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting “Delete.” This one-click action may create an inadvertent deletion, and the user would lose everything entered. Further, the delete button is located right next to the save button.</p>	<p>Medium (8)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities • User Stories 7, 9, 11, 21 	<p>Recommend separating the save and delete buttons to prevent the inadvertent deletion of information entered by the user.</p>
<p>Adding a new capability, sub-capability, work function, or work reduction opportunity is not explicitly intuitive. The design is a gray button to the right that will populate the database that feeds the drop-down menus per page. The association between this manage button and data may not be intuitive to new users.</p>	<p>Low (8)</p>	<ul style="list-style-type: none"> • Managing Capabilities • Managing Sub-Capabilities • Managing Work Functions • Managing Work Reduction Opportunities • User Stories 8, 10, 12, 22 	<p>Recommend changing the color of the “Managing” button to blue to make it more intuitive that the button can be selected by the user.</p>
<p>The fields that are provided on the labor, non-labor, BCM tabs, and Action Tracker tabs are technical in nature, specific to ION, and/or NPP convention and do not currently have explicit descriptions of what each fields are from the ICAP.</p> <p>The fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity.</p>	<p>Medium (6)</p>	<ul style="list-style-type: none"> • Success Criteria Tab • Labor Cost Reduction Worksheet Tab • Non-Labor Cost Reduction Worksheet Tab • BCM Task Builder Tab • Action Item Tracker Tab • Manage Organizations Tab • User Stories 16, 17, 18, 19, 20, 23, 24 	<p>Recommend providing additional help and guidance text to inform users how the fields are used and what information is needed for each of the fields.</p>
<p>Currently, the user guide information text only states select a work function and a related work reduction opportunity and does not state that a capability and sub-capability need to be selected</p> <p>User guide information text only states to select a work function and related work reduction opportunity and does not state that a capability and sub-capability need to be selected even though</p>	<p>Low (3)</p>	<ul style="list-style-type: none"> • Work Reduction Opportunity Tab • Work Function Tab • User Stories 13, 14 • Description Tab 	<p>Recommend adding help and guidance text to help the user understand what needs to be selected to continue using the tool.</p>

Issue	Priority	Location	Recommendations
other boxes to be selected are present.			
Icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These icons do not have an explicit label and may not be intuitive to users who are new to the ICAP.	Low	<ul style="list-style-type: none"> Technology Requirements Tab User Story 15 	Recommend adding labels to the icons to make their use more intuitive to users.

4.1.1 Innovation Portal Recommendations

The following recommendations from the heuristic evaluations and cognitive walkthrough for the IP tool will be listed in the sections below.

Table 9. IP recommendations.

Issue	Priority	Location	Recommendations
When scaling the IP home page, the labels on the home page can become garbled and reduce readability.	Low	<ul style="list-style-type: none"> Home Page User Story 1 	Recommend adjusting the IP home page to prevent scaling issues from occurring when resizing the browser window.
Linked and non-linked text is colored black on the pages, making it difficult to distinguish between linked and non-linked information without memorization.	High (3)	<ul style="list-style-type: none"> Functional Areas Page Advanced Capabilities and Integrated Technologies Page Enabling Technologies Page User Stories 2, 3, 4 	Recommend adjusting the text to differentiate between the text with linked and non-linked information.
Links in the home page are not alphabetized leading to increase search time to locate information.	Medium	<ul style="list-style-type: none"> Home Page User Story 1 	Recommend alphabetizing the links on the home page to reduce the search time to locate information.

5. CONTINUED EFFORTS AND NEXT STEPS

The usability findings from the heuristic evaluation and cognitive walkthrough have been presented to the SMEs and software engineer to identify areas where changes could be made to help enhance the user flow and ease of use of the ICAP and IP tools. Adding priority levels to the usability findings helps to focus in on the most challenging areas where the user may not be able to make additional progress. Recommendations were made based on the usability findings that would help users know what to expect and how they can progress through the tool to complete their tasks.

A future effort for this work is to continue adding IP tool information into prebuilt templates to begin populating the IP tool. The IP tool is intended for NPP utilities to use for innovation efforts by providing information on work reduction opportunities. An additional ongoing effort is work on the organizational structure of the IP tool. This effort is described in further detail in Section 5.1. Next steps for the IP tool are to meet with SMEs to review the information being added to the templates, discuss the usability findings, and decide on how to present the information for NPP utility stakeholders to use in the identification and development of innovations for work reduction opportunities.

The ICAP tool is currently under development to add features to help develop a business case. Budgeting information from BCAM is in the process of being added into the organizational section, so the next steps are to continue the development of the ICAP tool and then perform another usability evaluation of the tools when additional features and information are added.

5.1 Populating Content

One of the most basic and essential components of the IP is the content and information that will be available to users. The current organizational structure for this information breaks down the IP into three areas: 1) functional areas, 2) integrated technologies/advanced capabilities, and 3) basic technologies. To populate the IP with accurate and useful information without overwhelming users, human factors researchers interviewed SMEs, as described in an earlier section. Interviews were recorded, transcribed, and used to assist researchers in filling out template forms for topics on the IP. The templates include:

- A brief description of the topic
- The requirements for and benefits of implementing a given technology
- Available products relating to the topic
- Related functional areas and technologies
- Demonstrated and deployed resources
- A section for related standards, regulations, and guidelines
- A section for the name of a point of contact for the topic and related presentations/reports.

Thus far, the majority of templates for topics within the categories of integrated technologies/advanced capabilities and basic technologies have been fully or partially completed. Most topics categorized under functional areas require more assistance from SMEs. Templates will then be reviewed by SMEs to ensure the accuracy and appropriateness of the information to be uploaded to the IP.

5.2 Designing New Ways of Accessing Information

In addition to populating the IP with information, we are also considering the way in which the user finds and accesses the information within the website. The existing layout consists of a rather dense landing page, with each individual topic present and organized into the three areas mentioned previously: functional areas, integrated technologies/advanced capabilities, and basic technologies. The current landing page is presented below as figures through a series of screen captures.

5.2.1 Current Design

The screenshot shows the top portion of the LWRS website. At the top left is the LWRS logo and a navigation menu with links for Home, About, Contact, Document Library, and Tools. To the right is a search bar with a 'Search' button. Below this is a large grey banner featuring the LWRS logo and the text 'Hello, Innovators!' followed by the tagline 'Welcome to the place for business to drive innovation and support safe, reliable, and efficient operations.' A 'Get Started' button is centered at the bottom of the banner.

This screenshot shows a section titled 'FUNCTIONAL AREAS' with a green checkmark icon above it. Below the title are three buttons: 'Operations', 'Maintenance', and 'Support'.

This screenshot shows a more detailed view of the 'FUNCTIONAL AREAS' section. It features a green checkmark icon and the title 'FUNCTIONAL AREAS'. Below the title, there are three columns of sub-sections:

- Operations**
 - Operations
 - Chemistry
 - Radiation
 - Protection
- Maintenance**
 - Electrical
 - I&C
 - Mechanical
 - FIN/EFIN
- Support**
 - Engineering Planning
 - Design Engineering
 - PRA Engineering
 - Program Engineering
 - Work Management
 - Systems Engineering
 - Functional Area Management
 - Business Support
 - Maintenance Support
 - Administrative Services
 - Performance Improvement: CAP
 - Project Management
 - Regulatory Services
 - Outage Management
 - Procedures and Records
 - Nuclear Fuels
 - Nuclear Oversight
 - Training

This screenshot shows a section titled 'ADVANCED CAPABILITIES & INTEGRATED TECHNOLOGIES' with a green checkmark icon above it. A 'Top' button is visible in the bottom right corner.

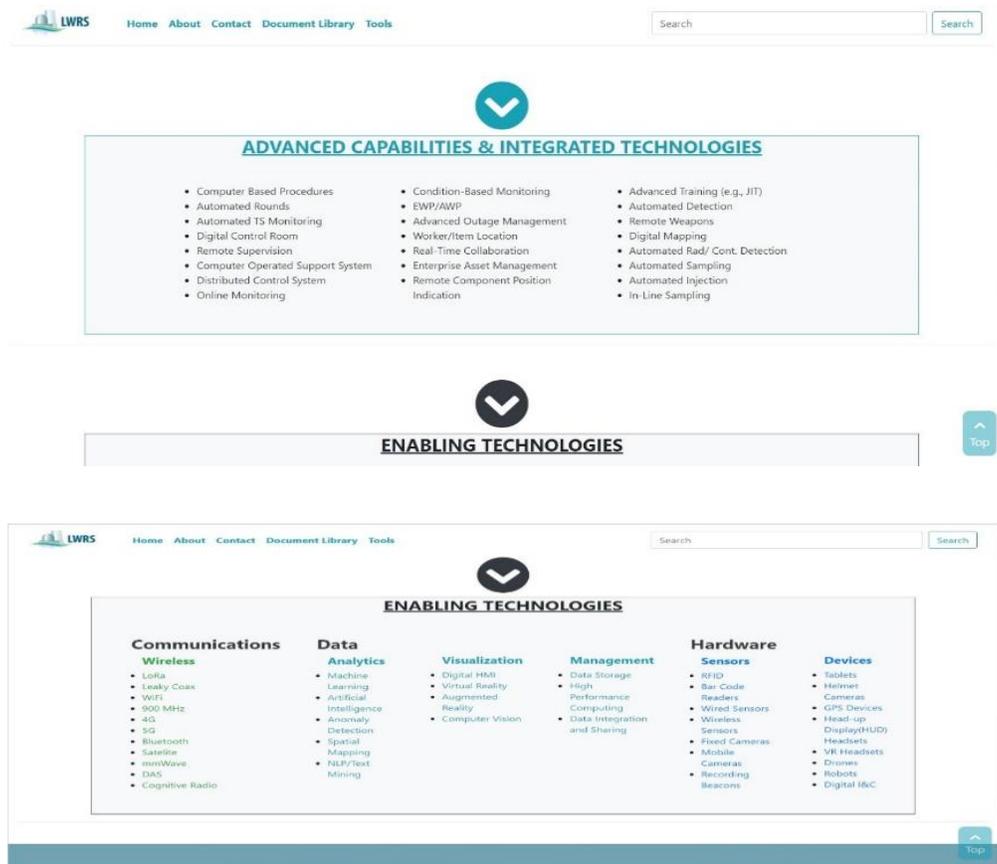


Figure 24. Current IP home page (Kovesdi, Thomas, Remer, Boyce 2020).

5.2.2 Proposed Design

A prototype of a new potential organization structure was created in Adobe XD. First, a simplified landing page is recommended. Jakob Neilson of Neilson Norman Group recommends that a landing page or homepage communicate the purpose and capability of the website in the most brief, simple, and to-the-point manner possible (Neilson 2001). While the broader intended purpose of the IP is clearly stated (“Welcome to the place for business to drive innovation and support safe, reliable, and efficient operations”) and the “Get Started” button indicates a seemingly clear path for users, the current organization of the website does not actually provide this path.

The proposed landing page, as seen in Figure 25, keeps the summary of the IP’s broader goal and the “Get Started” button, but clicking this button can lead users down two potential paths, based on the user’s knowledge and goals. The first would be considered a “top-down” approach. That is, users may come to the IP with a broader goal or end state in mind. For example, a user may be looking for ways to decrease operator workload or increase the security of a system but may not know the ways in which technologies or capabilities can support that goal. On the other hand, users may use the IP in a “bottom-up” manner, coming to the website with a specific technology or capability in mind but may not know the details of how implementing it would improve the current state.

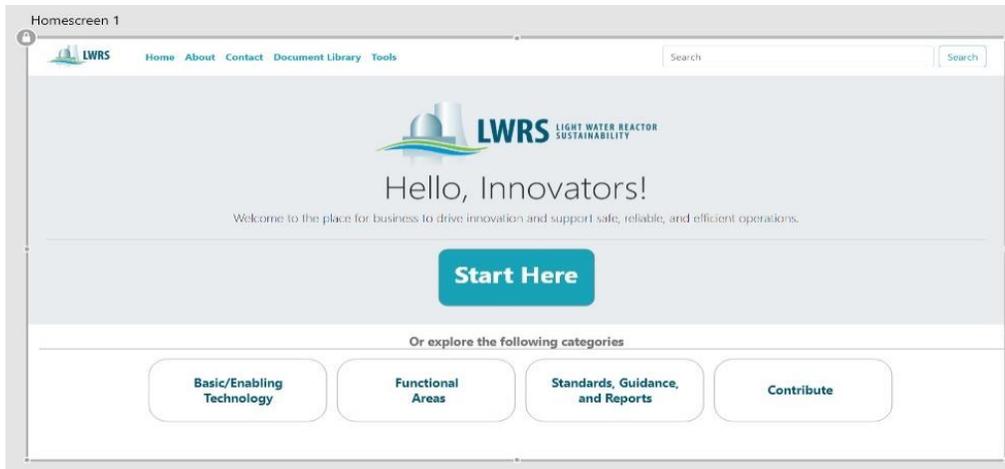


Figure 25. Proposed home page design.

Both use cases assume a degree of user exploration and discovery. However, a different hypothetical user may turn to the IP to answer a specific question or looking for specific pieces of information. To accommodate for this, the landing page also features a few short cuts. Two of these shortcuts lead to particularly information-dense resources, such as a list of basic enabling technologies and the standards, guidance, and reports that are references on the site. One proposed shortcut organizes topics by functional areas, similar to the original landing page. And the final proposed shortcut would link to a way for users to contribute and add information to the portal, although the mechanism through which this can be done is yet to be determined.

By clicking the “Start Here” button, users are presented with the two pathways outlined above, and as seen in Figure 26, may choose to “Explore advanced capabilities and integrated technologies” or “Explore goals and key performance indicators.”

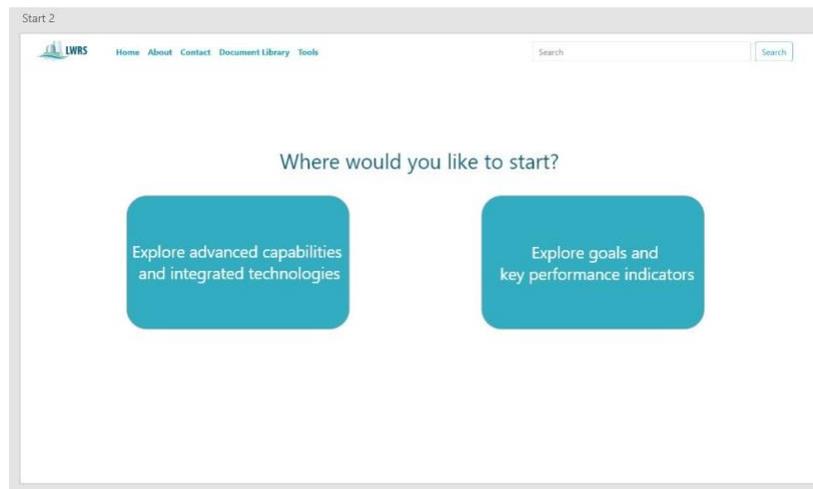


Figure 26. Proposed IP starting point.

If a user chooses the “top-down” path—that is, explore advanced capabilities and integrated technologies—a page similar to Figure 27 may be presented.

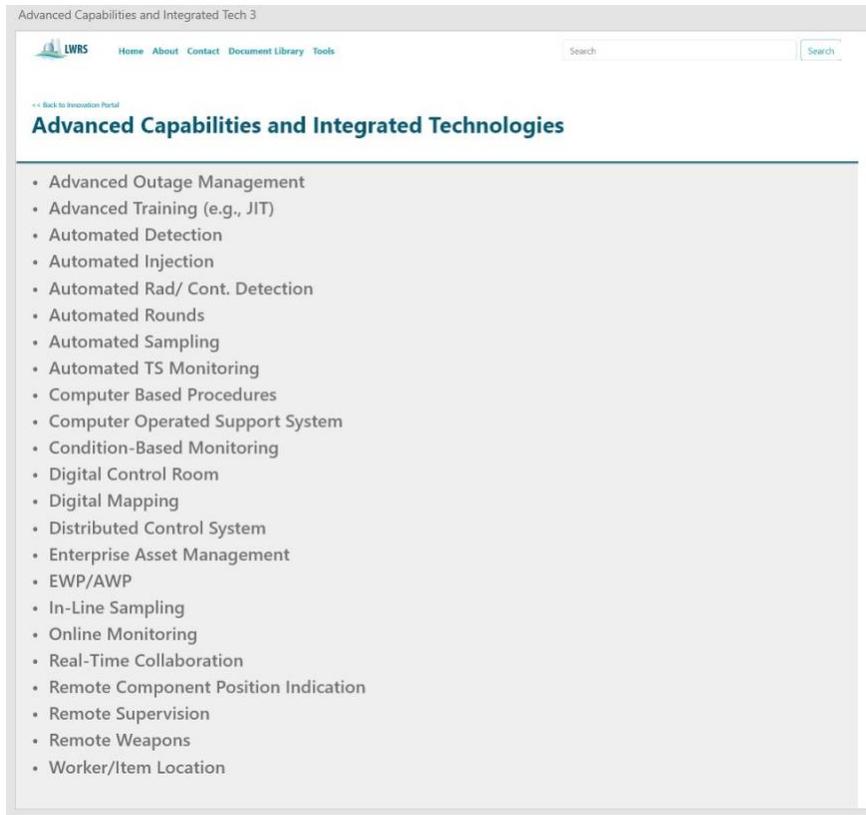


Figure 27. Proposed design for Advanced Capabilities and Integrated Technologies section.

This page presents users with the same information that was present on the original landing page underneath the Advanced Capabilities and Enabling Technologies category but alphabetizes the topics for easier searching. From this page, a user may select a topic to be taken to that topic's page. Figure 28 shows what the page for "Computer Based Procedures" would look like.

Computer Based Procedures

Description

Work instructions will be consistent across all organizations and will be streamlined to provide only task-relevant and compliance-relevant instructions to the user. Work instructions will be presented on a mobile device and users will have real-time access to supporting information, just-in-time training, and communications tools. Conditions encountered in the field will be documented with rich media and information will be updated in real-time to all relevant systems. Control room operators and decision makers will have real-time awareness of conditions in the field and better understanding of plant status.

Requirements/Benefits:

- **Remote monitoring of status (plant, equipment, procedure)**
 - Less time waiting
 - More precise scheduling
- **Automatic verification (correct component, worker qualifications, plant conditions)**
 - Fewer corrective actions
 - More efficient procedure execution
- **Real-time communication**
 - Improved communication
 - Less time waiting
 - More efficient procedure execution
- **Automatic updating (plant, equipment, record keeping)**
 - Better tracking of plant status
 - Fewer procedural conflicts
 - More efficient record keeping for compliance
- **Automatic tracking of administrative tasks (plackeeping, signoffs)**
 - More robust record keeping
 - More efficient procedure execution
- **Automatic processing of field data (calculations, checking tech specs, limits, thresholds)**
 - Fewer human errors
 - Fewer corrective actions
 - More robust record keeping
- **Dynamic/Context-sensitive Instructions**
 - Fewer human errors
 - Reduced time managing procedures
- **Capture of media in the field**
 - Better transfer of knowledge
 - Improved decision making
 - Faster resolution of emerging issues
- **Appealing user Interface**
 - Recruitment and retention of skilled workforce

Available Products:

- NextAction Electronic Work Management
- DataGlance
- ATR Smart Procedure
- LeanPower
- Tecstatom

Related Functional Areas:

- Operations
- Procedures and Records
- Maintenance Support
- Work Management

Related Enabling Technologies:

- 4G
- Wi-Fi
- Tablets
- Gas Cooled Readers
- RFID
- Wireless Sensors
- Mobile Cameras
- Data Storage
- Data Integration and Sharing

Applicable Standards, Guidance, and Reports:

- IEEE: 1786
- EPRI: 3002004316
- NRC: NUREG-6634 NUREG-0700 NUREG-0711 NUREG-0800
- LWRS: INL/EXT-15-35284

Demonstrated Resources:

- LWRS: INL-PVGS Collaboration

Deployment Resources:

- IAEA: Dynamic computer based procedures system for the AP1000 plant

Point of Contact:

Katya LaBlanc

Figure 28. Design template for Advanced Capabilities and Integrated Technologies section

Ideally, much of the text on this page would serve as hyperlinks to other pages within the IP such that users can easily explore related topics and technologies. For example, a user viewing the above page may be interested in learning more about a related enabling technology for computer based procedures, such as 4G. Clicking on this text would then take the user to a page dedicated to the topic of 4G, which would also identify and link to several related topics and technologies.

Alternatively, if a user instead takes the “bottom-up” approach or chooses to explore by goals and KPIs, a page similar to the one in Figure 29 could be presented.

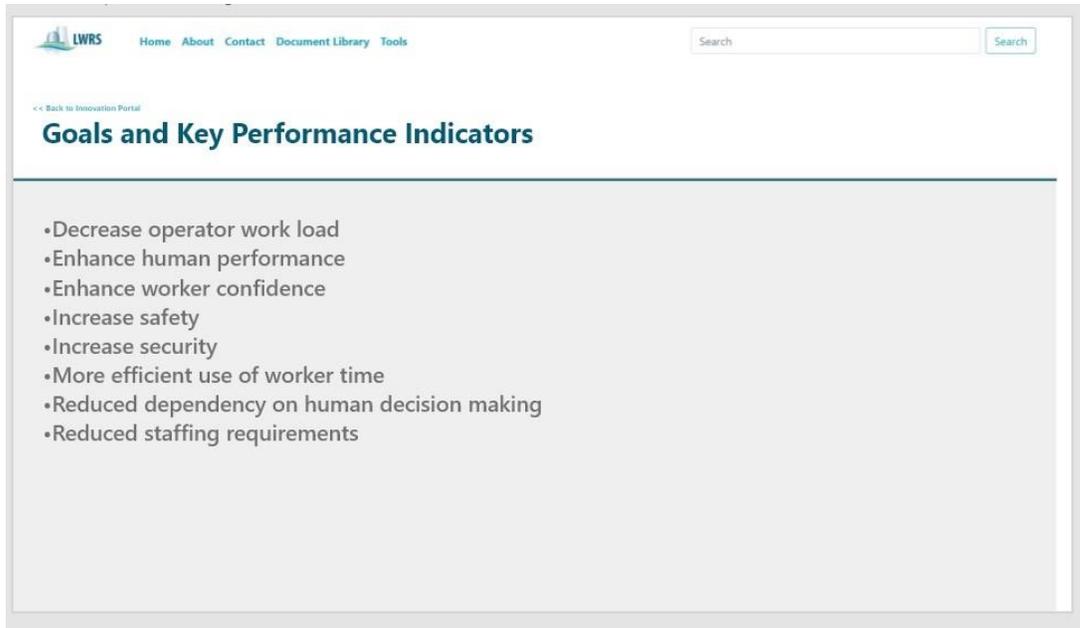


Figure 29. Proposed design for KPIs.

After clicking on a goal or key performance indicator, the IP would present users with the advanced capabilities or enabling technologies that have been identified as supporting the given goal. For example, by clicking “More efficient use of worker time,” one capability that would be suggested would be the topic of computer-based procedures.

Overall, the goal of redesigning the IP is to provide users with a variety of ways to explore, locate, and access relevant information without being visually overwhelming. The revised layouts of the IP shown in this section serve as examples of how this could be done.

6. CONCLUSION

The ICAP and IP tools were created as part of the ION effort to create a way for utilities to identify and implement work reduction opportunities to save on O&M costs. The capability stack model is used for developing the work reduction opportunities by adding PTPG information that will help build a business case that can model the process and strategies needed for implementing new technologies that will help save on business costs. Usability evaluations were completed on the ICAP and IP tools to learn how users will interact with the tools and identify areas where users may encounter issues. Recommendations were generated and will be provided to the LWRS research leads of the ION project on the areas where human factors design improvements can be made to help users achieve the goal of developing a business case for work reduction opportunities.

6.1 Limitations of Current Research

Some limitations of this research were that only two evaluators completed a review of the ICAP and IP tools. Having additional evaluators review the ICAP and IP tools once further developed will help to identify additional usability concerns that may halt the users progress when using the ICAP and IP tools. Another limitation of this research was that this usability evaluation of the tools was performed before additional features or capabilities were fully implemented. An additional review when new features are implemented is planned to help identify future usability errors before the tools are deployed.

6.2 Future Vision

The future vision of this effort is to continue developing the IP and ICAP tools for use in the ION effort. Currently, information is being populated for the IP tool to further develop the information for utilities to use with ION. The IP tool proposed design will be made available to the development team and ION effort SME's to review the new design for accessing information in the IP to help provide users with various ways to explore, locate, and access information without it being visually overwhelming. Once additional features and content are made available, another heuristic evaluation and cognitive walkthrough will be performed on the ICAP and IP tools to identify potential usability issues.

Another vision for future work is to begin external usability testing on IO utility users to identify how they will use the tool and any usability issues encountered. Having potential IO users test the usability of the tool will help to further redefine the tool for use in the ION effort.

7. REFERENCES

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Appendix A

Heuristic Evaluation Spreadsheet

ICAP Features	Location in ICAP and	Feature Functions	Heuristic Evaluation Methods					Heuristic	Synopsis of Issue	cur with I	Priority	ur with
			Schneiderman's 8 Golden Rules	Documentation for Schneiderman's 8 Golden Rules	Person Norman Heuristic	Documentation for Nielson Norman Heuristics	Images from ICAP/PIP					
		Function(s)						Match between System and the Real World	Issue 1. Unclear where to start beginning ICAP process based on current design. There are multiple ways to access ION layers, but there is no explicit instructions specifying how these layers fit together and where to first start. Formal training is needed.	Y	L	Y
Home Page	Home Page	Information and selection page	Offer informative feedback	Have information available to help the user understand how to start using the tool	Help and Document	Have information available to help the user understand how to start using the tool		Recognize, Diagnose, and Recover from Errors	Issue 2. Error messages appear when using the dropdown boxes in a reactive manner so opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns	Y	H	N
Manage Indicators (KPI's)	Under Capabilities tab	List of Key performance indicators used by the NPP.	5. Offer simple error handling.	5. Multiple error messages occur when selecting collaboration or other KPI metrics. Suggest offering guidance on the error and why it occurred.				Recognize, Diagnose, and Recover from Errors	Issue 2. Error messages appear when using the dropdown boxes in a reactive manner so opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns	Y	H	N
								Recognize, Diagnose, and Recover from Errors	Issue 2. Error messages appear when using the dropdown boxes in a reactive	Y	H	N
Capabilities Tab Section	Capabilities Tab Selected	Section for utility to enter current capabilities for PTPG and KPI's such as; operate the plant or maintain the plant.	3. Offer Informative Feedback-	3. Offer feedback to the user to show where they are in the process such as in showing status of completing a section.	1. Visibility of System Status-	1. Has ability to find capabilities that have been added to the section. Suggest changing the color from gray to blue to show		Consistency and Standards	capability, work function, or work reduction opportunity is not explicitly intuitive. The design is a gray button to the right that will populate the database that feeds the dropdown menus per issue 4. When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting Delete. This one-click action may create inadvertent deletion and the user would lose everything entered. Further, but button is located right next to the save button.	Y	L	N
	Capabilities Tab Selected	At the top of the hierarchy, the 'Manage Capabilities' tool allows a user to view and modify specific content for a created capability or manage (e.g., add or remove) capabilities	5. Offer simple error handling	5. Unable to retrieve data error occurs when selecting the capabilities tab.	10. Help and Documentation-	10. Currently missing user guide or information on how to enter information		Error Prevention		Y	M	Y
Viewing or modifying content for an existing capability	Capabilities Tab	User is able to view or modify the capability information	6. Permit easy reversal of actions	6. Allow the user to make necessary changes to the capabilities. The design allows for the information or new information to be revised and follows the heuristic.	6. Recognition paths	6. Options to save the information are visible allowing the user to recognize how to enter information		No changes	0 This is not an issue	N	n/a	N
Managing capabilities: adding a new capability		Allows the user to add new	4. Design dialogue to yield closure. 6. Permit easy reversal of actions	4. Adding in guidance for how to add a new capability would be helpful to the user for capability completion. 6. Users are able to exit out of adding a new capability easily.	3. User Control and freedom 10. Help and Documentation	3. User is able to exit adding a capability if desired allowing for user control. 10. Documentation or guidance may be required for		Medium	Issue 4. When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting Delete. This one-click action may create inadvertent deletion and the user would lose			

Managing sub-capabilities: adding a new sub-capability	Subcapabilities Tab	User is able to add new sub capabilities as needed.	1. Strive for consistency	1. create consistent standard for required information needed across the tool	4. Consistency and	4. Maintain consistency for required information for names and codes across the tool.		Low		I don't understand what was observed here.	N	n/a	N
Managing sub-capabilities: modifying or deleting an existing sub-capability	Subcapabilities Tab	User is able to delete or modify a sub capability in this section.	5. Offer simple error handling	5. Possibly add an additional pop up warning before deleting a record to prevent possible error of deleting a capability.	5. Error Prevention	additional pop up warning before deleting a record to prevent possible error of deleting a capability.		Medium		I don't understand what was observed here.	N	n/a	N
Work Function Tab	Work Function Tab	Selection of work functions based on the capabilities and sub capabilities of the plant.	N/A	N/A	10 Help and Documentation	10. Currently the help text only states for the user to select a capability and a sub-capability and not a work function.			Recognition Rather Than Recall	Issue 5. Icons are used in the work reduction opportunities page for adding, removing, and getting information on a technology on the technology requirements tab. These	Y	L	Y
Viewing or modifying content for an existing work function	Work Function Tab	User is able to select the work functions and add information as needed.	4. Design dialogue to yield closure. 6. Permit easy reversal of actions	4. Adding in guidance for how to add organizational information would be helpful to the user. 6. Users are able to exit out of adding a new capability easily.	10. Help and Docum	10. Add in guidance for organizational information such as a hover option would be helpful to early users.		Medium		I don't understand what was observed here.	N	n/a	N
Managing work functions: adding a new work function	Work Function Tab	User is able to add new work functions as needed.	1. Strive for consistency	1. create consistent standard for required information needed across the tool	4. Consistency and	4. Maintain consistency for required information for names and codes across the tool.		Low	Help and Documentation	Issue 6. The fields that are provided on the labor, non-labor, BCM tabs, and Action tracker tabs are technical in nature, specific to ION and/or nuclear power plant convention, and do not currently have explicit descriptions of what each fields are from the ICAP. (Help and Documentation)	Y	M	N
Managing work functions: modifying or deleting an existing work function	Work Function Tab	User is able to delete or modify a work function in this section.	5. Offer simple error handling	5. Possibly add an additional pop up warning before deleting a record to prevent possible error of deleting a work function.	5. Error Prevention	5. Possibly add an additional pop up warning before deleting a record to prevent possible error of deleting a work function.		Medium	Help and Documentation	Issue 6. The fields that are provided on the labor, non-labor, BCM tabs, and Action tracker tabs are technical in nature, specific to ION and/or nuclear power plant convention, and do not currently have explicit descriptions of what each fields are from the ICAP. (Help and Documentation)	Y	M	N
Work Reduction Opportunity Tab	Work reduction opportunity Tab	Used to identify work reduction opportunities.	N/A	N/A	10. Help and Documentation	10. Add in information for selections of information the user is supposed to enter in to add in work reduction opportunities.		Low	Help and Documentation	Issue 6. The fields that are provided on the labor, non-labor, BCM tabs, and Action tracker tabs are technical in nature, specific to ION and/or nuclear power plant convention, and do not currently have explicit descriptions of what each fields are from the ICAP. (Help and Documentation)	Y	M	N
Description Page	Work reduction opportunity Tab/description	Used to describe information related to work reduction	5. Strive for consistency	5. Meets heuristic standard for consistency across the tool	10. Help and Documentation	10. Add help and documentation for what the work reduction type and		Low		the labor, non-labor, BCM tabs, and Action tracker tabs are technical in nature, specific to ION and/or nuclear power plant convention, and do not currently have explicit descriptions of what each fields are from the ICAP. (Help			

Technology Requirements Page	Work reduction opportunity Tab/technology tab	User to map technology for supporting possible work reduction activities.	8. Reduce short term memory load	8. Use of the green button to is a good indicator for adding information but may benefit from text under for adding work reduction technology.	6. Recognition rate	6. Green button and other indications will help for better recognition but may benefit from initial text or over for what the item is for initial users.		Low	Error Prevention	Issue 4. When adding a new capability, sub-capability, work function, or work reduction opportunity, a user can delete data entered by selecting Delete. This one-click action may create inadvertent deletion and the user would lose everything entered. Further, but button is located right next to the save button.	Y	M	Y	
Success Criteria Page	Work reduction opportunity Tab	Tab is used for adding information or plan leading to success of implementing work reduction activities.	N/A	N/A	10. Help and documentation	10. Add help or additional information for information to be added to this section		Low	Help and Documentation	Issue 7. The fields in Manage Organization are generic in nature and may be difficult for a new user to accurately populate without familiarity. (Help and Documentation)	Y	M	Y	
Labor Cost Reduction Worksheet Page	Work reduction opportunity Tab/Labor Cost Tab	used to document potential labor savings from work reduction opportunities.	4. Design dialogue to yield closure	4. have description of what the terms mean for other potential users or newer users would be helpful for the user to understand what they are adding to the report.	2. Match between the system and the real world	2. Section has a lot of internal words to plant operations. Could help to have general terms or hover function with description of what the text means.		Low			0	0	0	0
Non-Labor Cost Reduction Worksheet Page	Work reduction opportunity Tab/Non Labor Cost Tab	used to document potential non-labor savings from work reduction opportunities.	4. Design dialogue to yield closure	4. have description of what the terms mean for other potential users or newer users would be helpful for the user to understand what they are adding to the report.	2. Match between the system and the real world	2. Section has a lot of internal words to plant operations. Could help to have general terms or hover function with description of what the text means.		Low			0	0	0	0
BCM Task Builder Page	Work reduction opportunity Tab/BCM Tab	Information will be used to develop a business case that ties into the BCAM software from epi. Information can be completed and turned into a downloadable table once completed.	4. Design dialogue to yield closure	4. have description of what the terms mean for other potential users or newer users would be helpful for the user to understand what they are adding to the report.	2. Match between the system and the real world	2. Section has a lot of internal words to plant operations. Could help to have general terms or hover function with description of what the text means.		Low			0	0	0	0
Action Item Tracker Page	Work reduction opportunity	Used for tracking actionable	4. Design dialogue to yield closure	4. have description of what the terms mean for other potential users or newer users would be helpful for the user to understand what they are adding to the report.	2. Match between the system and the real world	2. Section has a lot of internal words to plant operations. Could help to have general terms or hover		Low						

Managing work reduction opportunities: adding a new work reduction.	Work reduction opportunity Tab	Used to make changes to work reduction opportunities or adding new ones.	5. Offer simple error handling	5. Possibly add an additional pop up warning before deleting a record to prevent possible error of deleting a work function.	5. Error Prevention	5. Possibly add an additional pop up warning before deleting a record to prevent possible error of deleting a work function.		Medium	0	0	0	0
Manage Organizations	Manage Organizations Tab	Used for supporting organizational information	3. Offer informative feedback	3. Offer information to help the user enter organizational information into this section	10. Help and documentation	10. User guided information to help the user enter in organization information.		Medium	0	0	0	0
Innovation Portal	IP portal Home Page	Used to find information leading to work reduction opportunities and provides information and resources to customers.	3. Offer informative feedback.	3. Having descriptions or additional informative feedback may help new users understand the differences in phrasing.	10. Help and documentation	10. Add documentation for additional help for users using both the ICAP and IP tools.		High	0	0	0	0
Functional Areas Operations/Maintenance/Support	IP tool Functional areas Section on home page	Used for identification and information for available technologies and capabilities.	1. Strive for consistency 2. Enable frequent users to use shortcuts.	1. Some information is not selectable but has the same look as information with hyperlinks and should have a way to separate the information. 2. Some selections are hyperlinks and some are not, and should have a way to differentiate between what is selectable and what is informational.	6. Recognition ratio	6. Much of the information is selectable with hyperlinks but other information looks the same but is not selectable. Suggest using blue text for hyperlinks and different bullet type for items that are only informational.		High	0	0	0	0
Advanced Capabilities and Integrated Technologies	IP tool Advanced Capabilities Section on home page	Used for identification and information for available technologies and capabilities.	1. Strive for consistency 2. Enable frequent users to use shortcuts.	1. This section looks very different from the enabling technology and functional areas sections and could benefit from having a consistent format across all three sections. 2. Some selections are hyperlinks and some are not, and should have a way to differentiate between what is selectable and what is informational.	6. Recognition ratio	6. Much of the information is selectable with hyperlinks but other information looks the same but is not selectable. Suggest using blue text for hyperlinks and different bullet type for items that are only informational.		High	0	0	0	0
Enabling Technologies Communications/Data/Hardware	IP tool enabling technologies Section on home page	Used for identification and information for available technologies and capabilities.	1. Strive for consistency 2. Enable frequent users to use shortcuts.	1. Some information is not selectable but has the same look as information with hyperlinks and should have a way to separate the information. 2. Some selections are hyperlinks and some are not, and should have a way to differentiate between what is selectable and what is informational.	6. Recognition ratio	6. Much of the information is selectable with hyperlinks but other information looks the same but is not selectable. Suggest using blue text for hyperlinks and different bullet type for items that are only informational.		High	0	0	0	0

Appendix B

Cognitive Walkthrough Spreadsheet

User Stories										
Step #	SubCat (Component)	As a...	I want... (Summary)	So that... (Description)	Quotes, Notes, & Ideas (Comments)	Does the user know what to do or expect at this step?	Will the user know and make progress to competing their goal at this step?	Walkthrough Result(s)	Walkthrough Recommendation	Priority
1	User Login Access	User	the ability to create a user account for the ICAP tool	users can easily access the system		Yes	Yes	No improvements needed	N/A	N/A
2	User Login	User	the ability to user to access the ICAP tool	users can easily access the system by submitting their log in information.		Yes	Yes	No improvements needed	N/A	N/A
3	Home Page	User	to navigate to the home page after logging into the ICAP tool.	users can access and navigate options in the home page.		Yes if familiar with IO process/ No if newer user unfamiliar with IO	Yes (IO Professional)/ No (other)	Improvement needed	Currently there is not information to inform the user how or where to start when using the tool.	Low
4	Capability Tab	User	to see and select from the plant capabilities list	to add information relating to description and PTPG information based on the capability area. I can also view the KPI's that are related to the capability.	Top down approach to PTPG	Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the requirements needed	Yes if IO professional that understands how to develop the business case using PTPG and is trained on how to add in capabilities using the manage capabilities function. No if a user that does not understand the process.	Improvement needed	Error messages appear when using the dropdown boxes in a reactive manner as opposed to showing what is causing these errors from the user. The user has all available options in the lookup table available via dropdowns but if there is no data, the system sends error messages that the data field is blank as opposed to just graying out fields without data.	High
5	Manage Capabilities	User	the ability to manage capabilities and identify what capabilities have information relating to PTPG.	if additional information or capabilities need to be added.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement needed	Make selecting the manage button more intuitive to the user.	Medium

6	Manage Capabilities/ Add or Delete Capabilities	User	add or delete a capability	I can manage the capabilities available by adding additional capabilities that are not available or deleting capabilities as needed.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement Needed	Separate the distance between the add and delete buttons in this section to prevent inadvertent deletion of data.	Medium
7	Sub Capability	User	to find what plant sub-capabilities are available and related to selected capabilities	to add information relating to description and PTPG based on the sub-capability area. I can also view the KPI's that are related to the sub-capability selected.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	No improvements needed	N/A	N/A
8	Managing Sub-Capabilities	User	the ability to manage sub-capabilities and identify information relating to PTPG and the description.	I can add additional information or sub-capabilities as needed.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	No improvements needed	Make selecting the manage button more intuitive to the user.	Medium
9	Manage Sub-Capabilities/ Adding or Deleting Sub-Capabilities	User	add or delete a sub-capability	I can manage the sub-capabilities available by adding to or deleting sub-capabilities as needed.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement needed	Separate the distance between the add and delete buttons in this section to prevent inadvertent deletion of data.	Medium
10	Work Function Opportunity Tab	User	the ability to select the associated work functions based on the capabilities and sub-capabilities selected.	I can add information on the associated organizations can be entered along with other requirements and PTPG information.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	No improvements needed	N/A	N/A
11	Managing Work Functions	User	the ability to manage work functions	Add or delete work functions to the capabilities and sub-capabilities.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement needed	Make selecting the manage button more intuitive to the user.	Medium
12	Manage Work Functions/ Adding or deleting work functions	User	Add or delete work functions as needed	identify additional work functions that need to be added or remove work functions that are not needed.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the process.	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement needed	Separate the distance between the add and delete buttons in this section to prevent inadvertent deletion of data.	Medium

14	Managing Work Reduction Opportunites	User	to manage the work reduction opportunities selected and add to them or delete them as needed	information can be added to develop a business case for work reduction opportunities		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	Yes if IO professional that understands how to develop the business case using PTPG. No if a user that does not understand the process.	Improvement needed	Make selecting the manage button more intuitive to the user.	Medium
15	Description Page	User	add a description of the work reduction opportunities and select the related work reduction opportunity area.	begin to develop a business case for developing work reduction opportunities related to the work reduction area.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
16	Technology Requirements Page	User	to add technologies that will help in developing the work reduction opportunities and information that will help develop a business case.	I can identify technologies that will help to create work reduction opportunities		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
17	Success Criteria Page	User	the ability to add success information based on the previous pages that will aid in developing a business case for work reduction opportunities.	I can estimate the levels of success such as, risk and difficulty levels that it would take to use the technologies in the plant for work reduction opportunities		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
18	Labor Cost Reduction Worksheet Page	User	to add information based on potential labor and labor savings related to the work reduction opportunities	I can develop a business case for labor savings by indentifying what resources are needed to be successful.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
19	Non-Labor Cost Reduction Worksheet Page	User	To add information based on non-labor costs and potential savings.	I can develop a business case on the cost of non-labor savings		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
20	BCM Task Builder Page	User	enter in information related to building a business case using the BCM information	I can add information that can be downloaded into the BCM tool that will help to develop the business case for work reduction opportunities.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium

21	Action Item Tracker Page	User	to add information related to action items to be assigned to responsible personnel in charge of the work reduction opportunity.	I will have personnel responsible for the work reduction opportunity and list any concerns or potential issues.		Yes if an IO professional that understands what information is needed for development of the PTPG to develop a business case No if unfamiliar with PTPG and the	No because information is not able to be added at this time.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
22	Starting from the Work reduction Opportunity section for bottom up process	User	Start at the bottom by identifying work reduction opportunities first before selecting capabilities and other information.	I can find technologies to meet the goals for work reduction opportunities.	Bottom up start on the PTPG process	Yes if an IO professional the user would know what they are expecting to find for work functions. No if not an IO professional due to not having enough information on	No do to the capability to select and enter information into this section is not currently present.	Improvements needed to add capability of adding information into the page to complete the process.	Add capability for information to be entered into this section for the user to complete their task.	Medium
23	Starting with the Work Function section	User	If the user wants to start from the work functions section	I can find what capabilities and sub-capabilities are that relate to work functions.	Middle of process for developng the PTPG	Yes if an IO professional the user would know what they are expecting to find for work reduction opportunities. No if not an IO professional due to	Yes if the IO professional knows what capabilities, sub-capabilities, and work reduction areas to select before selecting work reduction opportunities. No if the user does not know the above	No improvements needed for IO professional	Help and documentation my help newer users to understand what information is needed in this section	Medium
24	Innovation portal home page	User	Select the Innovation portal	I can see what technologies could help to develop a business case for work reduction opportunities		Yes	Yes	Improvement needed	Prevent readability issues from occurring when scaling	Low
25	Innovation portal home page	User	Select the Innovation portal	I can see what information is available that I am interested in.		Yes	Yes	Improvement needed	Make locating information simple by alphabetizing the information.	Medium
26	Selecting links in the Functional Areas section	User	Select hyperlinks for information in this section I am interested in.	I can learn more about the functional areas		Yes	Yes if the information they are seeking is available. Possibly No if the information the user is looking for is not available.	Improvement needed	an opportunity for improvement is to make adjustments to the text so users can tell the difference between linked and non-linked	High
27	Selecting links in the Advanced capabilities and integrated technologies	User	To find information in the advanced capabilities and integrated technologies section	I can find or learn about ways to reduce costs by using technology.		Yes	Yes if the information they are seeking is available. Possibly No if the information the user is looking for is not available.	Improvement needed	an opportunity for improvement is to make adjustments to the text so users can tell the difference between linked and non-linked	High
28	Selecting links in the Enabling Technologies section	User	To see what technologies could help with work reduction opportunities for business savings.	the technologies could be found that will help with work reduction opportunities.		Yes	Yes if the information they are seeking is available. Possibly No if the information the user is looking for is not available.	Improvement needed	an opportunity for improvement is to make adjustments to the text so users can tell the difference between linked and non-linked	High
29	Manage Indicators	User	manage the KPPs that are related to the capabilities and sub-capability sections						Add additional information for how users can add or interact	

Appendix C

ICAP and IP Discussion and Walkthrough

Objectives:

The INL Human Factors team would like to set up one (1) hour with you to:

- To understand your underlying mental models that have driven the development of the ICAP and IP tools
- To understand how the ICAP and IP tools can be better leveraged by the ION effort
- To learn more generally how the ICAP and IP tools will be used by companies to help with their transformation processes
- To identify intended users of the ICAP and IP tools regarding integrated operations (IO) so that we can develop human factors “use cases” that will help with the usability aspects of these tools.

During this time, we would like to use a combination of semi-structured discussion and walkthrough of the ICAP and IP tools to meet the objectives listed. During the walkthrough, we plan on using the INL/EXT-20-59827 report to gain additional knowledge on how the software tools will be used.

The INL Human Factors team would also like to record the meeting to serve as an internal informational resource, as part of completing the DOE milestone for this work.

Semi-Structured Discussion and Walkthrough:

Prior to initiating the discussion, INL researchers should thank the SMEs for their time and interests in participating in this activity. The INL HF team should remind SMEs that 60 minutes were reserved for this activity, but any time is appreciated.

The following discussions questions are intended to be used as guidance to support the objectives described in the above section.

Questions	
SME Questions	SME Responses
Purpose of the ICAP: <ul style="list-style-type: none"> • What is ION and how is it used in industry? • Could you explain the purpose of ICAP development from your view (mental model)? • How will the ICAP and IP tools be used by utilities to help with their transformative process? • Please explain the capability model and how it is used in the transformative process to someone that has never heard of it before. • Would the NRC review the ICAP and IP tools once development has been completed? • Has the IO methodology been used in any nuclear or oil and gas operations in the United States? 	

<ul style="list-style-type: none"> • Once the ICAP process is completed, what does the end state show and represent? • Please explain who the users of the ICAP tool are and how they will be involved in completion of the ICAP process. 	
<p>ICAP Features:</p> <ul style="list-style-type: none"> • Is the organization mapping in the ICAP tool similar across different utilities? 	
<p>Using the ICAP:</p> <ul style="list-style-type: none"> • Are KPIs generated or does each utility enter in their own KPIs? 	
<p>Supporting Tools for Capabilities Assessment:</p> <ul style="list-style-type: none"> • Please explain how the above is used in the ION process. 	
<p>Capabilities Assessment</p> <ul style="list-style-type: none"> • Please explain how the above is used in the ION process. 	
<p>Capabilities Tab:</p> <ul style="list-style-type: none"> • Please explain how the above is used in the ION process. 	
<p>Sub-Capabilities Tab:</p> <ul style="list-style-type: none"> • Please explain how the above is used in the ION process. 	
<p>Work Functions Tab:</p> <ul style="list-style-type: none"> • How are work reduction opportunities identified when using this section? 	
<p>Work Reduction Opportunity Tab:</p> <ul style="list-style-type: none"> • Is a report available once the user completes this section explaining the business case or would the user have to interpret the findings? 	
<p>Innovation Portal Purpose and Features:</p> <ul style="list-style-type: none"> • Please explain how the innovation portal and its features and how it will be used in the ION process. 	
<p>Using the Innovation Portal:</p> <ul style="list-style-type: none"> • How do you envision utilities using the IP in the ION process? 	
<p>Data Management for the Innovation Portal:</p> <ul style="list-style-type: none"> • How do you envision data management to take place in the IP? 	
Developer Questions	
<p>User Role Questions:</p>	

<ul style="list-style-type: none"> • Are there plans to include a user guide for how to use the software tools? • How will training on the software be completed with users to learn how to enter the information into the ICAP tool? • What are the plans for maintaining the ICAP and IP tools if users have any potential issues? • How are different utilities able to be represented when entering information into the ICAP tool? (Such as different utilities that are interested in using the software.) 	
<p>Design Specifications:</p> <ul style="list-style-type: none"> • How were specifications for designing the website provided to you? • Were specifications provided by NPP or INL or both for designing the ICAP and IP tools? • How is the information entered into the ICAP saved? • Is it saved under each individual user or can multiple users in a utility all access the entered information? • Was any user testing performed on the ICAP and IP tools? If so, please explain what types were completed. • Is the information from the utility saved or would a utility have to complete a new report once completed? • When selecting the BCAM excel insert, is the BCAM software required or is it included when downloading the excel form? • Is information from the IP software tool able to be automatically entered into the ICAP tool when adding information? • Some information in the IP software tool is clickable, while other information is only readable. Does all the information in the IP tool contain hyperlinks or is some information only for reference? • What were some of the requested design specifications of the software tools requested by NPP? • What were some of the design requests for the software tools INL requested? 	