



*Benchmarking the Way to Quality Improvement*

Process and Quality Improvement

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## Table of Contents

Executive Summary .....	3
Introduction.....	4
Braidwood Nuclear Generating Station .....	4
Process and Safety Quality .....	5
Quality Control .....	6
Method .....	6
Benchmarking: A History .....	7
Benchmarking: Core Concepts .....	7
Benchmarking: Testing Methods .....	10
Benchmarking: Critical Success Factors and Barriers .....	12
Results.....	15
Competitive Benchmarking .....	15
Functional Benchmarking .....	15
Assessment.....	16
Specific Examples of Benchmarking .....	20
Benefits/Challenges of Benchmarking at Exelon .....	21
Discussion .....	22
Strengths: .....	22
Weaknesses .....	24
Implementation .....	25
Recommendations:.....	26
Future of Exelon .....	28
Lessons Learned.....	29
Works Cited .....	31
Appendix A.....	34

## Executive Summary

### Introduction:

Exelon is the current leader in electrical energy production. As the trends in the energy market frequently changes over time, Exelon maintains its position by focusing on the core values it holds as a business and seeking out new investment opportunities. The Braidwood Nuclear Generating Station, as well Exelon's other locations, must constantly analyze and control its systems and processes to adjust to regulations, safety concerns, quality improvements, and new investment opportunities. Exelon leverages various quality improvement tools, including benchmarking, to perform this analysis and control process.

### Methods:

Benchmarking is a key quality improvement tool used across industries to effectively analyze and compare processes internally and to those of outside organizations. This method was popularized in the United States by the Xerox company, who became a figurehead for successful benchmarking methods. Benchmarking is divided up into internal, competitive, functional, and generic benchmarking, each of which can be used to improve various business processes. Researchers have developed various frameworks and templates for completing self-assessment and establishing a benchmarking process. Benchmarking relies on the establishment of key performance indicators, which are measured and analyzed using various analytical tools, such as Data Envelopment Analysis. Even well planned benchmarking projects can face barriers to benchmarking in the form of time, personnel, and resource constraints. Critical success factors, such as organizational commitment, can work to mitigate these key barriers.

### Results:

Benchmarking is a widely used method for continuous improvement in the Nuclear Energy Industry according to [REDACTED], Senior Reactor Operator at the Braidwood nuclear plant. Exelon takes a multi-faceted approach to benchmarking by combining internal, competitive, functional, and generic benchmarking into their improvement process. By combining this benchmarking approach with standard procedures, such as the Corrective Action Program, Exelon has been able to save money and mitigate potential danger, particularly at the LaSalle location. Exelon continues to benefit from the use benchmarking, but it does not come without risk and cost. Resource scarcity, schedule conflicts and operational costs are a few barriers that Exelon must face in attempts to continuously improve their operations through benchmarking.

### Discussion:

Exelon's organizational vision for quality is exemplified in its successful approach to benchmarking. The top level managerial commitment has allowed benchmarking to flourish within the organization by minimizing some of the key barriers. Exelon's unique approach to benchmarking allows for the study of best practices across industries, thereby providing ample opportunity for quality improvement. This approach is combined with highly-rated Corrective Action Programs to highlight key processes within the organization. Exelon's approach is not without weaknesses, which vary from poorly chosen benchmarking strategies, a single-track analysis methodology, and allowing other benchmarking barriers to continue unchecked. To improve benchmarking at Exelon, the group recommends benchmarking for customer satisfaction, leveraging big data analytics, and doing more to minimize barriers to benchmarking success. Exelon's is working to leverage new technologies to improve quality in the future.

## Introduction

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It is not a simple task becoming the America's leading company in electric energy distribution. A feat which is currently held by the Exelon Corporation, a fortune 500 company with a mission of retaining this title. To achieve this goal, a rigorous progression to optimize levels of quality is necessary to provide the earth with clean and affordable energy. Due to the quickly changing energy industry, Exelon has conducted a series of strategies to add diversity to the company and allow itself to adapt to the continuously changing climate. With new legal hurdles, advancements in technology, and changing trends to deal with, Exelon believes that holding and preserving the core values of the company while incorporating itself with the evolving nature of the energy market is the best path for the company to take.

### ***Braidwood Nuclear Generating Station***

Exelon was formed at the turn of the new millennium through a merger between PECO Energy and Unicom Corp (Exelon, n.d.). The company is currently made up of several subsidiaries with multiple plants generating electricity various ways to millions of people every year. One of most unique and notable ways that the company generates electricity is the splitting of uranium atoms in a process called "fission". The process generates nuclear energy by splitting the atoms to create heat. This heat is then used to boil water into steam that flows through a turbine generator to produce electricity (Exelon, n.d.). This is the main method of energy generation used by the Braidwood Nuclear Generating Station, a nuclear powerplant located in Braidwood, Illinois. The plant uses two nuclear reactors that produce 2,389 megawatts of energy to provide electricity to nearly two million homes (Exelon, n.d.). ComEd is the Exelon subsidiary that currently operates the plant which has provided power to the Will, Grundy, and Kankakee county areas for the last 30 years (Exelon, n.d.).

### *Process and Safety Quality*

As a major producer of energy, the Braidwood Nuclear Generating Station must always keep safety as a top priority within its continuous processes. This concern for safety is especially necessary due to the volatile nature of the nuclear reactions and the radioactive byproduct that is produced. Braidwood is continuously tasked with monitoring the levels of radioactivity and the reactions it may have on the environment, while also controlling internal factors within the facility to prevent any injury that may come from the physical production of electrical energy. If an event were to occur that caused the plant to experience an issue with the reaction process, the results could potentially be catastrophic. In recent years, the Braidwood plant has been accused of allowing thousands of gallons of water contaminated with tritium, a byproduct of the reaction process, to leak into the surrounding environment (Chase and Hopkins, 2017). However, after several safety and quality reviews by internal and external protection agencies, the issue was reported as not being a threat to the public. After the accusation, the plant continues to monitor the safety of the reaction process and make any necessary improvements to ensure the production of electricity runs smoothly and with the least threat to the industry and the surrounding areas as possible.

In addition to constantly monitoring safety, the company must also continuously improve itself to meet the demands of an ever-growing population while keeping current systems and processes up to date. Recently, due to improvements and continuous management, the two nuclear reactors used by the Braidwood plant were given extensions on their licenses to remain in operation until 2046 and 2047 (Exelon, 2016). Since building new reactors is very expensive for Exelon to achieve, the company must do everything it can to maintain the reactors that are currently in operation to ensure they are able to run efficiently and continuously for several

years. However, there are also times when a reactor gets to a point where it can no longer operate at the necessary standards or the company decides to invest into new opportunities. At times like these, the company must strategize for the construction of a new reactor or a complete restoration of an older one.

### ***Quality Control***

Process control is a very important step in the maintaining and improving of operations. Years of strategic development research is used to ensure current and future systems are operated without error. Whether the company decides to improve one of its nuclear reactors, run safety tests on the environment, or even invest in new opportunities, the company must have some degree of observation and control over each action it decides to partake in. For events such as these throughout the business world, several strategies and tools have been created to ensure optimum levels of accuracy and process quality are achieved no matter what the task or project may be.

Exelon is responsible for safely providing electricity through numerous different procedures. There are many quality tools that can help them attain the quality output they desire. The method of benchmarking allows a company such as Exelon to continuously improve their operations.

### **Method**

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Whether it be in the energy, manufacturing, or service industry, any organization looking to gain or maintain competitive advantage in the marketplace must utilize one or more quality improvement tools in their overall organizational strategy. Once such improvement tool, benchmarking, is prevalent in all industries and is a key part of any total quality management policy. Benchmarking can be generally defined as a methodical approach to measuring and

evaluating an organizations processes, products, or services against an industry's best practice, but the overall definition is known to vary from industry to industry. (Moriarty and Smallman, 2009) In order to establish a more complete understanding of the benchmarking process, the following sections will analyze the history, core concepts, methodology, and critical success factors, and future trends in benchmarking.

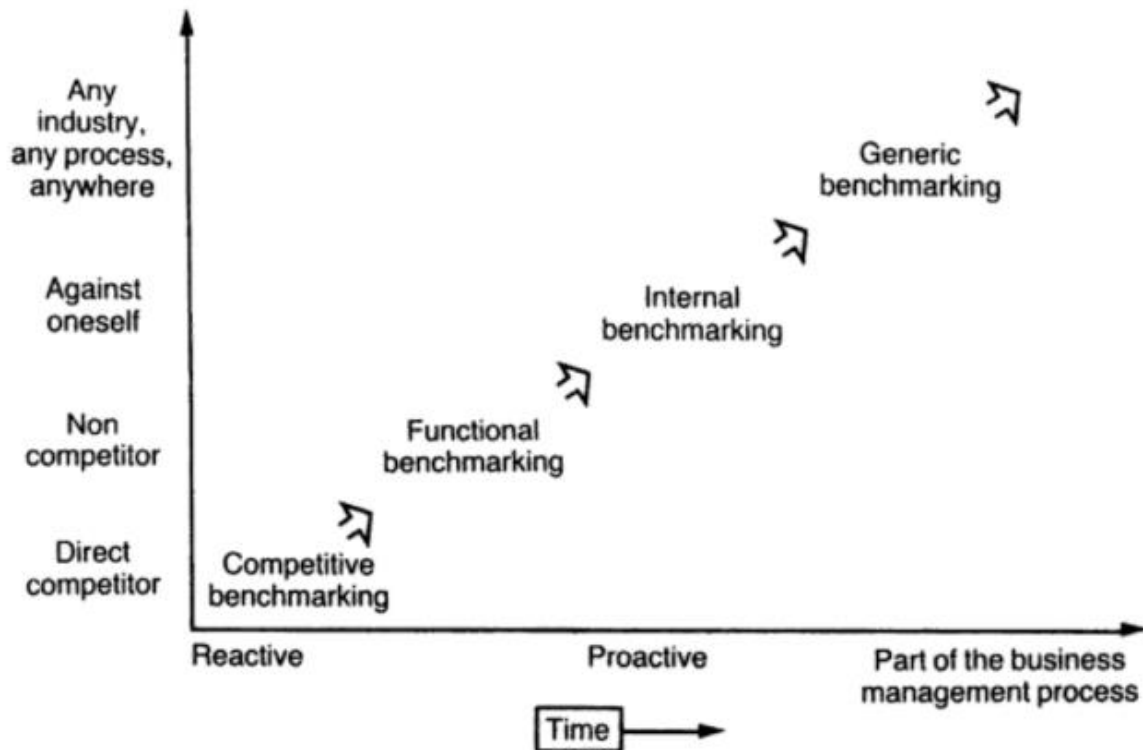
### ***Benchmarking: A History***

Before one can fully analyze the concept of benchmarking for quality improvement, it is important to first establish the history of this methodology. Benchmarking was popularized in the United States by the Xerox corporation 1980s after successfully incorporating the concept into its overall Total Quality Management plan. (Rogers et al., 1995) After a steady decrease in market share to both foreign and domestic competitors, Xerox top management began to study the differences in performance and quality between these competitor firms, and by using this data, the organization was able to not only improve the financial situation and market share of the company, but also to improve the overall quality of the product. (Rogers et al., 1995). Xerox then became a figurehead for successful benchmarking implementation in the United States marketplace, which encouraged the development of industry sponsored benchmarking coalitions across the country. (Nickerson and Sloan, 1999) Current research by Adebajo et al. (2010) concludes that benchmarking is not only used by many organizations across the globe, but also is similarly successful in improving overall quality when compared to other improvement tools.

### ***Benchmarking: Core Concepts***

When an organization first decides to incorporate benchmarking into their quality management strategy, the organization must choose the type of benchmarking it wishes to pursue. Benchmarking is commonly divided into internal and external benchmarking, with

further subdivisions including competitive, functional, and generic benchmarking. (Lema et al., 1995) The different classifications of benchmarking can be most easily understood through the figure below.



*Figure 1: Classification of Benchmarking Types. Zairi and Leonard (1994)*

The first external type of benchmarking, competitive benchmarking, involves evaluating one's own processes against the major competitors in the marketplace. (Lema et al., 1995) This approach can have significant costs and barriers in industries without benchmarking coalitions, as it can be difficult to obtain the specific data necessary to benchmark against a competitor's process. The second type of external benchmarking under this classification is functional benchmarking, which involves the evaluation of business functions, like distribution and logistics, versus the industry best practices. (Lema et al., 1995) Generic benchmarking is often considered a subset of functional benchmarking due to its overall similarity, but it differs in its



emphasis on comparing multifunctional business processes regardless of the organization's size or industry. (Lema et al., 1995) Finally, internal benchmarking occurs within an organization and can be used to compare similar processes, business units, quality progress, and other key factors at a single period or over a length of time. This is heavily used within multinational organizations to set an internal standard across countries. (Lema et al., 1995). To assist organizations in this decision process, Hanman (1997) developed an easy-to-read chart to assist organizations in deciding the best method for benchmarking depending on the organizational focus and the vision for the benchmarking project.

Table 1 Where to Start the Benchmarking Project						
Who participates  Activity	Internal Benchmarking	External Benchmarking				
		Two companies			Five –eight Companies	Many Companies
		Same industry		Different industries		
		Competitors	Non competitors		Different industries	Different industries
Quantitative focus (KPIs)	YES	POSSIBLE	YES	YES	YES	YES
Process discussions and site visits possible	YES	UNUSUAL	YES	YES	YES	No
Confidentiality concerns	NO	YES	NO	NO	NO	YES
Achieve understanding of best practice	NO	NO	UNLIKELY	UNLIKELY	LIKELY	POSSIBLE

*Figure 2. Deciding on a Benchmarking Project. Hanman (1994)*

Once the proper benchmarking methods are chosen within the organization, it recommended for the organization to perform a self-assessment to properly document the goals and vision of the organization's quality strategy and benchmarking project. After thorough research on the different benchmarking frameworks within the manufacturing industry, Voss et al. (1994) was able to establish a generic six step process for performing this self-assessment and benchmarking plan. These six steps created by Voss et al. (1994) can be summarized as follows:

1. Classify the processes that will be benchmarked
2. Create a framework for the processes using a top-down approach
3. Identify the best practices and their related sub-processes and features using a bottom-up approach.
4. Establish metrics
5. Create official tools, frameworks, and self-assessments for the benchmarking process
6. Ensure the frameworks and tools are feasible and add value

During the fourth step in this process, the key performance indicators relevant to the benchmarking process are specified within the organization. These are often related to costs, time, defects, or productivity. It is these specific metrics that are analyzed and compared either internally or externally during the benchmarking method. In addition, Voss et al. (1994) encourages the combination these six steps with their innovation framework to aid in continuous quality improvement and innovation across an organization.

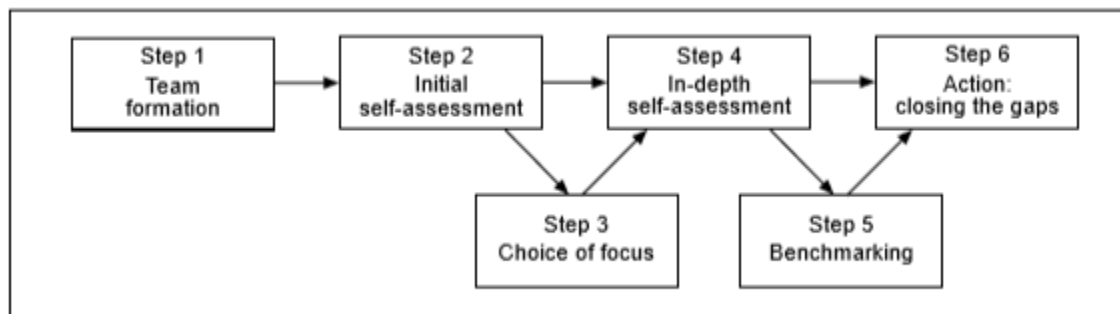


Figure 3. Innovation Framework. Voss et al. (1994)

### ***Benchmarking: Testing Methods***

Now that an organization has established the benchmarking method, selected a process to be benchmarked, designated appropriate metrics, and developed a benchmarking team, it can begin to collect and analyze data on the process. One of the most widely known methods for evaluating organizational efficiency is Data Envelopment Analysis (DEA), which uses decision making units (DMUs) to measure productive efficiency. (Stewart, 2010) This method outputs benchmarks for the DMUs that are least efficient, but Stewart (2010) proposes a method of

enriching the standard DEA process by modifying the benchmarks to better broach the gap between "monitoring and control...to management planning." (p. 14) This data is often analyzed with a variety of additional statistical and graphical methods to gain a more complete understanding of the underlying process and to gain business intelligence. Following is a key example of benchmarked data analyzed graphically, including a visual of the best practice area.

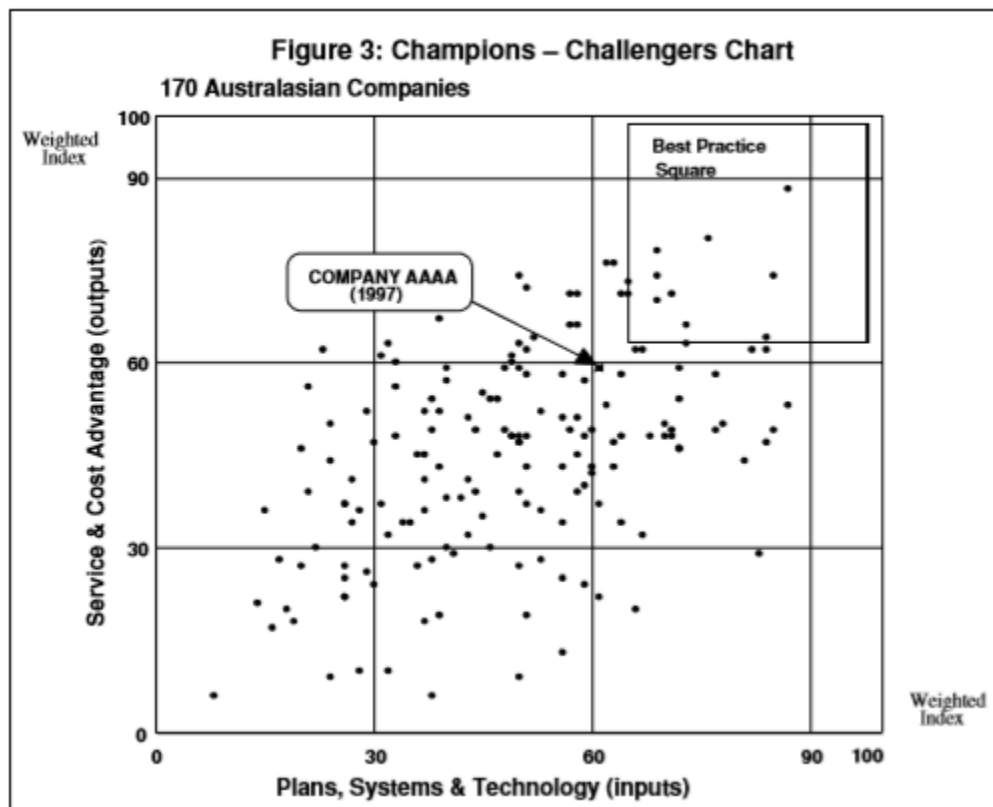


Figure 4: Best Practices Square. Hanman (1997)

Other researchers suggest employing a combination of activity-based costing and DEA to improve the overall efficiency of benchmarking in a cost setting. Troutt et al. (2000) developed a new method for obtaining efficiency data, which can pinpoint timeframes and organizational units with a high degree of efficiency variation. The results of this model yielded a more accurate efficiency benchmark versus a standard DEA method. (Troutt et al., 2000) Although DEA is widely used both alone and in conjunction with other statistical analysis, the DEA method is not

without its drawbacks when it is used for benchmarking. This method works under the assumption that all organizations included within the analysis have identical goals, objectives, and production possibilities. Furthermore, research performed by Ross and Droge (2001) theorized that a large proportion of business decisions fail due to improper analysis tools and poor managerial decision-making. Therefore, it is vital for an organization to research existing analytical methods or develop their own criteria before making any process changes.

Unfortunately, this data collection and analysis step does not prove easy for management or the benchmarking team. Statistical analysis becomes extremely difficult in many benchmarking contexts due to the exceedingly large number of variables from a variety of data sources.

(Nickerson and Sloan, 1999) In order to solve this data variability, Nickerson and Sloan (1999) establish data reduction techniques using principal component analysis and exploratory factor analysis, which essentially optimizes the variable inputs in the overall analytical process.

### ***Benchmarking: Critical Success Factors and Barriers***

No matter how well-developed a benchmarking model, the overall organizational structure, culture, and resources can have a significant negative impact on the success of a benchmarking project. In a study performed by Augusto et al. (2008), researchers emphasized the necessity for both traditional systematic benchmarking using statistical methods as well as benchmarking the practical characteristics of the organization. After studying some of the top performers in the Portuguese marketplace, Augusto et al. (2008) identified a correlation between certain practices and characteristics within a company and the overall level of performance. The following diagram lists the priority level and use of certain practices within leading firms as studied by Augusto et al. (2000):

## Practices and characteristics of the leading firms: A summary of the field studies

Practices and characteristics	Level		
	High	Medium	Low
Use of strategic planning	X		
Use of strategic information systems	X		
Use of competitive analysis	X		
Have systematic e-business practices and strategy	X		
Top management involvement	X		
Use of forecasting models	X		
Use of JIT		X	
Use of automated production systems	X		
Use of benchmarking	X		
Use of TQM and CI	X		
Use of process re-engineering		X	
Use of information systems to promote efficiency and quality of the operation	X		
Use of production planning models	X		
Use of Root-cause analysis	X		
Use of reliable suppliers	X		
Use of electronic information exchange with suppliers		X	
Use of JIT with suppliers		X	
Use of customers focus groups and surveys	X		
Use of customers profiling	X		
Use of customers satisfaction tracking on a long-term basis	X		
Use of joint programs with customers to promote quality improvements	X		
Use of employees performance tracking systems	X		
Use of employees rewards systems	X		
Use of information system to promote communication with employees	X		
Use of profit-sharing plans for employees		X	
Use of systematic promotion and termination policies	X		
Maintain strong relationships with the community	X		
Adhere to laws and regulations related to the natural environment		X	

Figure 5: Best Practices and Characteristics. Augusto et al. (2000)

As seen in the list above, each of these leading organizations had a high level of commitment to quality, and they often employed a variety of quality management techniques, including benchmarking. Most surprisingly, these leading firms did not always have a high level of commitment to environmental laws and regulations, despite the industry. In addition to these general characteristics, it is vital for top management to be committed to the benchmarking and over quality process. Even if an organizational aligns itself with the leading practices and characteristics, there can still be significant barriers preventing a successful benchmarking project within the organization. Research performed by Rogers et al. (1995) identified key barriers faced by leading organizations through surveys from both lower level employees as well

as top management across industries. The respondents in Rogers et al. (1995) research surveys ranked various barriers on a scale of one to seven, and the results are categorized as follows:

Barrier	Mean[a]
Time constraints	4.92
Competitive barriers	4.80
Lack of personnel resources	4.58
Low awareness of benchmarking methods	4.44
Lack of technical expertise	4.26
Cost of benchmarking	4.04
Lack of financial resources	3.97
Organizational structure	3.90
Lack of employee commitment	3.70
Organizational complexity	3.64
Difficulty understanding concepts	3.56
a 7-point scale:	

*Figure 6: Barrier Rankings. Rogers et al. (1995)*

In this survey, one was considered "not a problem", seven was considered an "extreme problem", and four is considered a moderate problem. (Rogers et al., 1995) As seen in the figure above, "time constraints", "competitive barriers", "lack of personnel resources", "low awareness of benchmarking methods", "lack of technical expertise", and "cost of benchmarking" were all rated as moderate to severe problems within the organization. These barriers can be largely mitigated by an organization with an established commitment to quality, which is demonstrated by the vision and actions of top management. This commitment ensures that adequate resources are provided to employees, whether it be through formal training, blame-free error reporting, change coaches, or financial support, and these resources ensure that employees can raise process concerns at any level of the organization.

## Results

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Our group interviewed [REDACTED] Senior Reactor Operator at Exelon. Allison Marshall provided the connection to [REDACTED], who we interviewed through email. First, we had to start by collectively gathering 25 questions regarding benchmarking that were also relatable to his job at Exelon. After conducting research and finalizing our questions Allison emailed [REDACTED] who promptly responded. We were fortunate enough to learn that benchmarking is widely used in the nuclear power industry and as a Senior Reactor Operator, [REDACTED] is very knowledgeable on the subject. Benchmarking provides Exelon with the means to continuously improve the quality of their entire operation. To continuously improve, they must also continuously benchmark.

### ***Competitive Benchmarking***

Exelon is constantly engaged in the practice of competitive benchmarking, which is where they review other competitors in the industry and determine if they should use them as a benchmark to potentially better their own processes. Just because a certain method of procedure works at a different organization does not mean that it will seamlessly transfer to the processes in place at Exelon. So, they must also factor in the applicability of a process prior to adopting it. Therefore, benchmarking through visiting other sites is imperative. It allows an Exelon member to see the inner workings and more easily determine the potential of it being a good fit at Exelon.

### ***Functional Benchmarking***

In cases where benchmarking against competitors is not available or necessary, Exelon can benchmark amongst themselves. Functional Benchmarking is used to identify their own sites that are outperforming others and learning why they have become successful. Members from different sites will travel to the successful location and observe the processes and assess

what their site can learn from the way they do business. [REDACTED] explained to us that Exelon uses functional benchmarking primarily to improve the refueling and online processes.

### ***Assessment***

A more intricate part of using the benchmarking technique is finding a method to quantify the information gathered from visiting a different site. It cannot be expected of an employee to individually collect information and make recommendations accordingly. Exelon uses a Corrective Action Program (CAP), Self-Assessment, Performance indicators and other methods to analyze specific parts of a company's process. Secondary and external data from various benchmarking coalitions is also used to identify areas that are declining in performance. Data from these sources such as INOP, Fleet Assessment, WANO and others analyzes and presents the data as information of the station. This will allow a site to grasp when it is necessary to benchmark against other locations because a process may be trending in the wrong direction. Once all this information is processed Exelon can make informative decisions on whether to adopt the new process or not. The result of having a clearly laid out plan to adopt a new method or procedure is an intricate process. Quality tools that were previously described must be standardized within each plant so that the quality of data collected is the highest it can possibly be, which will also lead to a higher quality of information provided from the site visit.



### Highest rated/successful corrective action program of surveyed

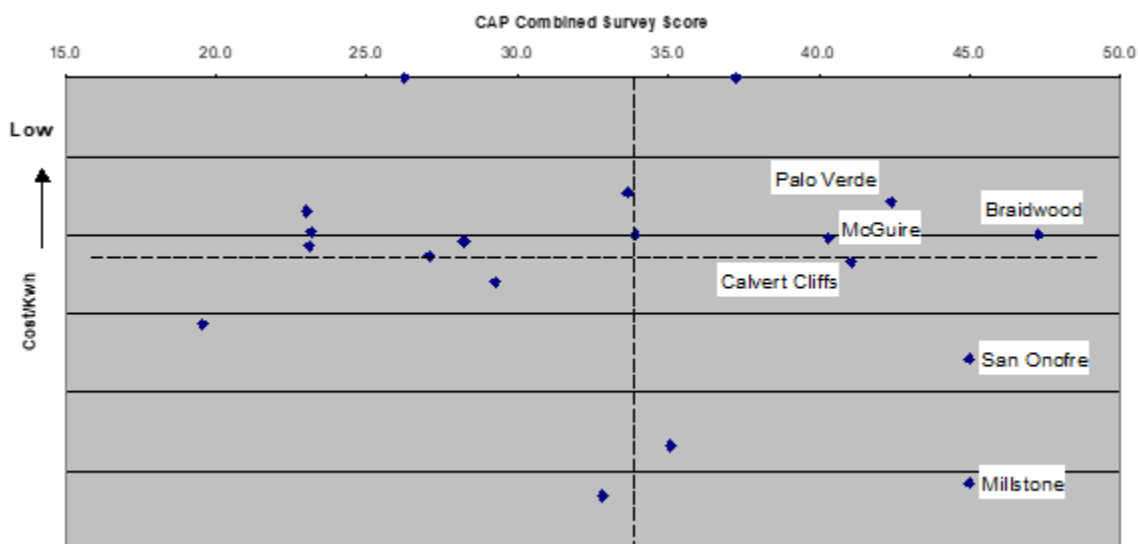


Figure 7: CAP Rankings. NEI Benchmarking Report (2000)

The chart above displays the data collected from numerous plants that were surveyed to review the productivity of their CAP assessments in benchmarking. Braidwood is shown as having a low cost, yet highly effective CAP procedure.

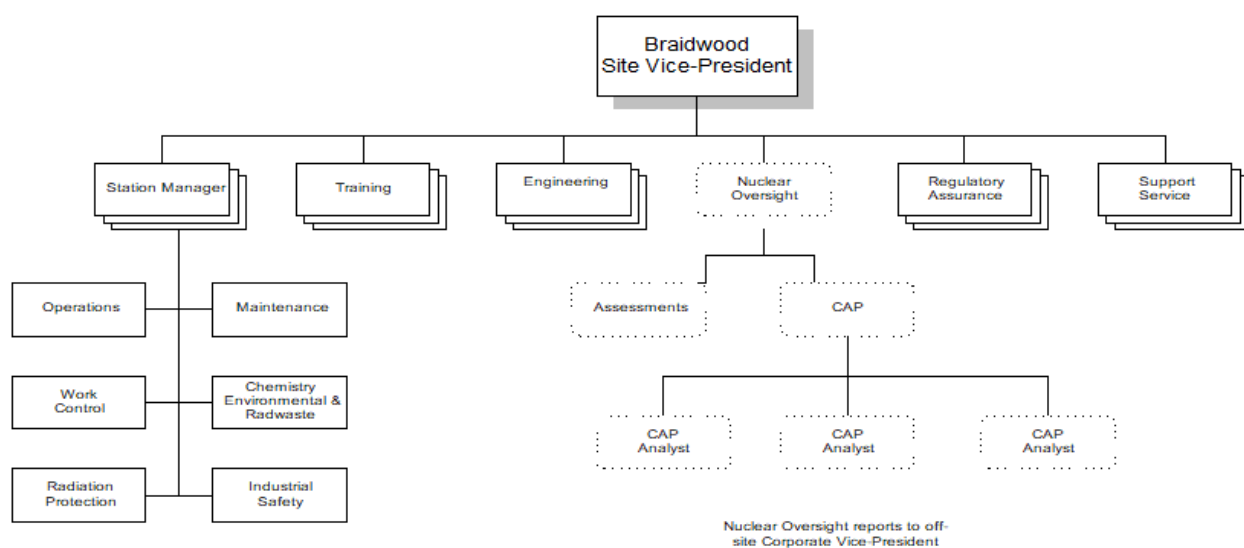


Figure 8: Braidwood Organizational Structure. NEI Benchmarking Report (2000)

This structure properly displays that all levels of the nuclear sector are responsible for CAP and benchmarking procedures. The continuous improvement in all areas is a joint effort.

Metric	NPI Max	Best Quartile	Median
<b>Safety</b>			
All Injury Rate (#/200k hours worked)		0.66	N/A <sup>1</sup>
Rolling Average <sup>2</sup> Industrial Safety Accident Rate (#/200k hours worked)	0.20	0.00	0.02
Rolling Average <sup>2</sup> Collective Radiation Exposure (Person-rem per unit)	80.00	42.25	61.60
Airborne Tritium Emissions (Curies) per Unit <sup>3</sup>		1,014	2,410
Fuel Reliability Index (microcuries per gram)	0.000500	0.000001	0.000001
2-Year Reactor Trip Rate (# per 7,000 hours)	0.50	0.00	0.05
3-Year Auxiliary Feedwater System Unavailability (#)	0.0200	0.0000	0.0015
3-Year Emergency AC Power Unavailability (#)	0.0250	0.0001	0.0024
3-Year High Pressure Safety Injection Unavailability (#)	0.0200	0.00000	0.00003
<b>Reliability</b>			
WANO NPI (Index)		92.9	85.8
Rolling Average <sup>2</sup> Forced Loss Rate (%)	1.00	1.03	1.29
Rolling Average <sup>2</sup> Unit Capability Factor (%)	92.0	89.44	86.49
Rolling Average <sup>2</sup> Chemistry Performance Indicator (Index)	1.01	1.00	1.00
1-Year On-line Deficient Maintenance Backlog (work orders per unit)		159	212
1-Year On-line Corrective Maintenance Backlog (work orders per unit)		11	20

Figure 9: Common Nuclear KPIs. NEI Benchmarking Report (2000)

The image above does not pertain specifically to the Braidwood plant, but it is a great representation of commonly used benchmark metrics for those in this industry.

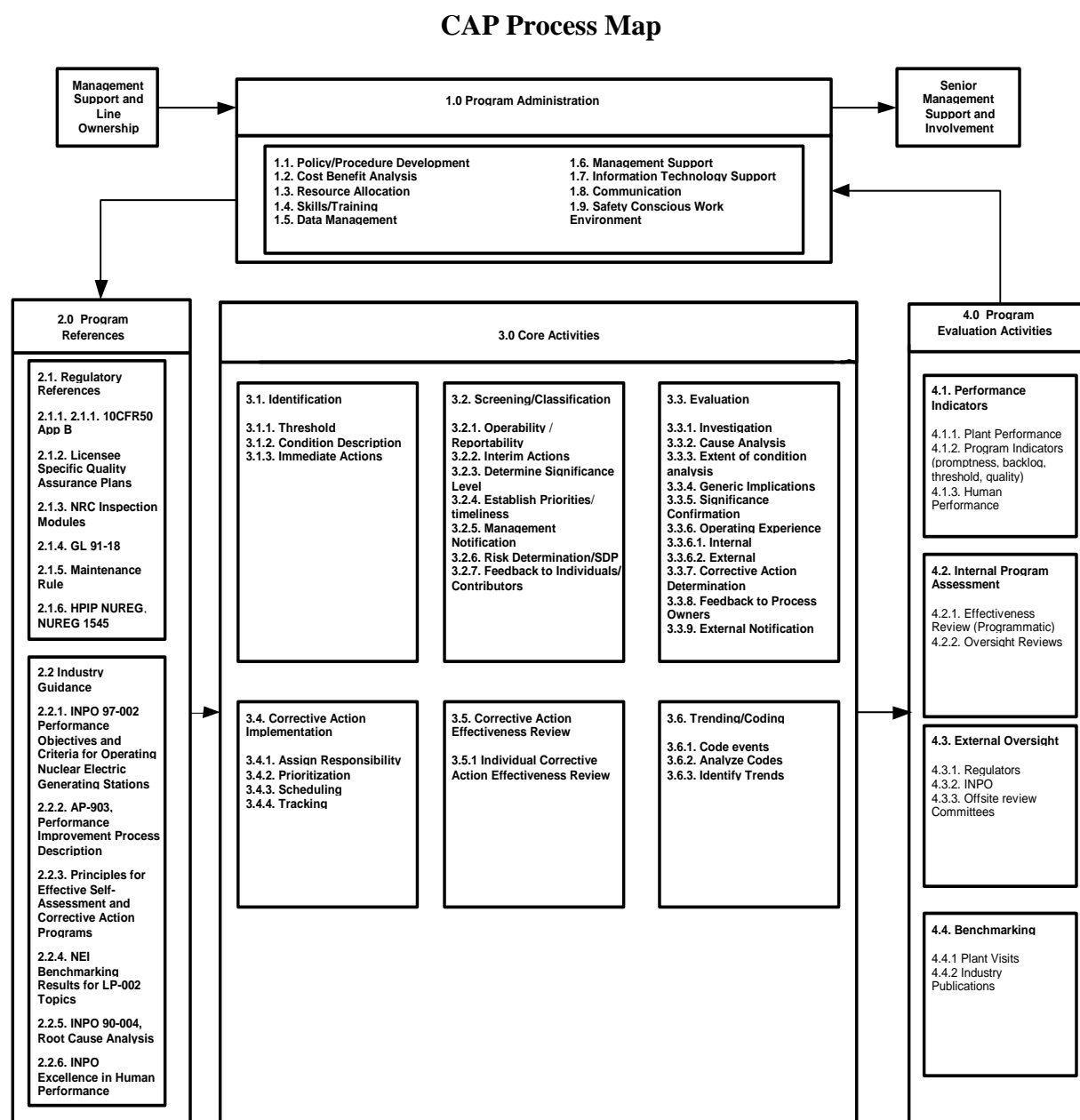


Figure 10: Corrective Action Program Process Map. NEI Benchmarking Report (2000)

This process map does not pertain to the Braidwood plant either. [REDACTED] was very generous in what he did provide to us, but legal matters prevented him from providing certain information. The CAP map shown above illustrates the standardized process that is similar among their sites. Process maps such as this provide the means for workers to follow guidelines when assessing a competitor's site.

### *Specific Examples of Benchmarking*

**Lasalle:** At one point the LaSalle location was having an unacceptable number of reactors shut down due to “water level control issues”. The forced shut down is detrimental to the company by losing valuable time and potential safety hazards. The frequency of this occurrence presented a great benchmarking opportunity. Research was performed on the external data to identify other options that are available to control water levels. Once the potential solution of adding a “digital control system” was recognized, they had simultaneously narrowed down the sites that they would benchmark at. They visited sites with the current digital control system in place. Finally, after collecting all the data and providing information to Exelon, they finally made the switch to the same system that they had learned about on their benchmarking visits. Since the upgrade, they have maintained almost zero reactor water level control shutdowns since.

**Going Green:** Another firm example of the benefits they have received from benchmarking is their going green initiative. Exelon’s goal is to reduce their amount of energy consumption to the lowest level while still maintaining their high-quality output. Exelon will functionally benchmark to reduce each sites energy consumption by breaking down the energy consumed into categories of component: lights, vehicles, computers, and more. They then will use statistical methods from the data that they have collected to determine which improvements can be made to each category of component.

Also, Exelon will competitively benchmark against the “green housing” initiative throughout the entire country to always improve. These benchmarking efforts have led to Exelon changing to LED bulbs, providing smarter buildings with better insulation and automatic lighting. It may seem trivial, but these labors will greatly reduce energy consumption for plants as big as the ones the Exelon operates.

### ***Benefits/Challenges of Benchmarking at Exelon***

Benchmarking is a tool so commonly used that it has become a standardize process at Exelon and throughout the nuclear power industry. Certainly, the benefits of using benchmarking are the reason that it remains so prevalent. Exelon has upgraded in many ways using benchmarking, but these upgrades do come with a cost.

#### **Benefits:**

- There are large Nuclear Information Exchange Institutions where many nuclear power plants share information between each other so that the best processes can be adopted worldwide.
- Safety, efficiency and other procedures are continuously reviewed and improved, if necessary
- Reduction of waste and energy consumed through benchmarking competitors.

#### **Challenges:**

- Costs for sending workers on site visits can be extensive depending on the location and duration of the visit.
- Opportunities to benchmark can be scarce at times, due to the constant changing environment. A plant may not be able to operate at max capacity with certain workers gone, or their site is being visited by others.
- Heavy workload, conflict in schedules and distance required to travel are all roadblocks that can potentially derail a benchmarking opportunity.

Overall, there almost seems to be a non-reaction by the workers due to the constant use of the benchmarking improvement method. It is so intertwined within their process improvement operations that these site visits and reviews are expected by the workers. The logistics of

traveling to a site may illicit an individual reaction from those traveling but, benchmarking is widely adopted at Exelon, and in the nuclear power industry.

## Discussion

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After establishing an understanding of the history of Exelon, analyzing the benchmarking methodology, and reviewing the compiled interview results, the group can now effectively examine and discuss the finer points of Exelon's benchmarking implementation process. This analysis will include Exelon's benchmarking strengths, weaknesses, effectiveness, and additional recommendations.

### *Strengths:*

#### **Management Commitment to Benchmarking:**

Exelon has established a commitment to quality in its core vision and values since its founding in 2000, which is communicated throughout the organization through various initiatives by top management. This commitment has allowed benchmarking and other quality management strategies to flourish within the organization by working to minimize the various barriers to success as studied by Rogers et al. (1995). For example, the organization grants flexible scheduling for individuals involved in the benchmarking process in attempts to minimize issues with time constraints. Managers also arrange replacements for off-site visits, as well as arranging the trip and covering all necessary expenses. While the costs of this method can be high, the organization understands the necessity of external benchmarking for both safety and the overall bottom line. Furthermore, Exelon provides templates and training to ensure employees at all levels understand the benchmarking process. This provides a clear framework for quality improvement in the organization, as well as minimizes the highly rated "low awareness of benchmarking methods" barrier as discussed by Rogers et al. (1995).

**Multi-faceted approach to benchmarking:**

Benchmarking is a highly customizable process and can be used to benchmarking both key performance indicators varying from safety measures to overall characteristics of an organization. Exelon works to maximize the benefits of benchmarking by taking a customized, multi-faceted approach to this quality improvement process. As discussed by [REDACTED] in the interview, Exelon leverages data from a variety of sources to pursue internal, competitive, functional, and generic benchmarking. In doing so, Exelon can ensure it is comparing its own performance to the best practices both within the industry as well as outside of it. Furthermore, Exelon is highly involved in benchmarking coalitions and information exchange programs, which can encourage significant innovation within an industry according to research performed by Nickerson and Sloan (1999). Overall, Exelon uses this tailored benchmarking approach to ensure peak performance across business processes.

**Corrective Action Programs**

Exelon strengthens its overall benchmarking strategy by employing Corrective Action Programs (CAP). According to the authors of the Corrective Action Benchmarking Project (2000), these corrective action programs help to pinpoint the best practices contributing to the success of the organization. By documenting, evaluating, and improving the issues impacting quality, Exelon can benchmark this data both internally and externally to make organizational improvements. The success of this CAP is supplemented by the high level of employee engagement in the process as well as the use of computer systems to track program data. Per the CAP rankings in Figure 7, Exelon is overall implementation of CAP benchmarking is ranked the highest against competitor plants. According to Hanman (1997), this performance ranks it as one of the best practice organizations for this program.

## ***Weaknesses***

### **Barriers to Benchmarking:**

Despite Exelon's commitment to quality at the managerial level, the organization still faces significant barriers to benchmarking due to time, cost, and resource constraints. Managers attempts to mitigate the time constraints by offering some flexibility for employees performing the benchmarking visits, but these on-site and off-site walkthroughs can still end up being rescheduled and cancelled. Furthermore, these benchmarking site visits must be scheduled around peak performance times, which can minimize the exposure to processes occurring only during outages that should also be monitored for benchmarking. Furthermore, Exelon does not have any formal change management program, which is ranked as a moderate to severe problem in the research performed by Rogers et al. (1995). A formal change management program is necessary to minimize the change resistance in an organization when instituting the process changes brought on by benchmarking.

### **Choosing a Benchmarking Strategy:**

Prior to the tritium leak issue in 2006, Exelon was benchmarking against federal minimum environmental standards rather than the industry best practices for tritium processing. This benchmarking method was not designed to improve this process beyond minimum standards, so it still allowed for leak levels within general regulations. Exelon faced a major scandal when environmental surveys discovered high levels of tritium that had spread into the surrounding groundwater. This could have been prevented by choosing appropriate benchmarking partners in the initial phases of the planning process. If Exelon had been performing competitive benchmarking against the industry best practices from the beginning, the organization could have implemented a quality monitoring and improvement strategy that prevented the tritium leak.



**Methodology:**

Exelon emphasizes the use of proprietary methods for data assessment and analysis for benchmarking, such as the corporate Performance Improvement Action Plans (PIAP). While the organization has been generally successful in using these self-developed analytical methods in their benchmarking strategy, this method can make it difficult to compare benchmarked data across organizations. Many organizations first turn to Data Envelopment Analysis for benchmarking data using designated Decision-Making Units. (Stewart, 2010) External data collected by Exelon for benchmarking may be organized based on input values or output values from prior data analysis. If Exelon wishes to compare their performance to an organization who has shared DEA outputs, then they would have to perform additional analysis or work backwards to extrapolate data values for the competing organization. This can lead to wasted resources when considered in the scale of an organization like Exelon.

***Implementation***

Based on the key concepts of the general benchmarking methodology, results of benchmarking at Exelon, and the overall strengths and weaknesses of this implementation, the group would rate Exelon's approach to benchmarking as highly effective. Before benchmarking even begins at Exelon, the top management of the organization ensures that the vision of quality is shared by all levels of employees through rigorous training and quality initiatives. Employees are provided clear frameworks for the benchmarking process as well as the necessary resources to pursue quality goals. In addition, Exelon's multi-faceted approach to benchmarking ensures that the organization is pursuing a variety of best practices to find performance gaps across business processes. Benchmarking projects were successfully used to eliminate reactor shutdowns caused by water levels at the LaSalle location as well as improve the environmental impact of energy usage across plant locations. These projects are supplemented by the highly-

rated Corrective Action Program, which both encourages employee involvement and pinpoints areas of excellence or improvement. Furthermore, the information exchange encouraged by benchmarking and quality coalitions across the nuclear power industry ensure Exelon has the data resources necessary to benchmark against its top competitors. The group is unable to perform additional quantitative analysis on the effectiveness of the benchmarking projects at Exelon as the nuclear power regulators and Exelon classify this data.

### ***Recommendations:***

While Exelon has proven itself successful in implementing benchmarking projects in the past, the group generated three major recommendations based on the interview data, organizational weaknesses, and methodology researched in the prior sections. [REDACTED] has indicated an interest in reviewing our final report, including these recommendations.

### **Benchmark for Customer Satisfaction**

As discussed in part during the company's history, Exelon had a major issue in the 2000s, which involved a Tritium leak into the groundwater of the area surrounding the Braidwood Nuclear plant. This led to significant damage to both the company's reputation as well as the trust given to the company by the surrounding community. According to research performed by Rogers et al. (1995), over 50% of top firms currently performing a benchmarking project were benchmarking customer service, and those organizations who had benchmarked customer service in the past rated the process the most successful of their benchmarking projects. Exelon is a vast organization with multiple subsidiaries, so both internal and external benchmarking can be effectively implemented to assess customer service levels and make possible process changes. For Exelon to utilize this customer service benchmarking, they must first specify the indicators they wish to measure. We would recommend beginning with customer satisfaction (as measured

through surveys) and resolution rate specifically for the ComEd customers. This data can then be analyzed using DEA and other statistical methods and compared to other Exelon subsidiaries, such as PECO, as well as the industry bests for customer service.

### **Big Data Analytics**

Recent technological advancements have improved an organizations ability to analyze larger and more complex data sets. While the data reduction techniques proposed by Nickerson and Sloan (1999) can be effective in ensuring that the chosen inputs are the most efficient, this method can still have its drawbacks. In reducing the overall variable inputs in an analysis, it is possible to remove data that could indicate previously unknown relationships within the data set. Furthermore, many of the current analytical techniques require highly-structured data, whereas big data analytical methods allow for non-structured, partially structured, and structured data. The nuclear power industry collects vast amounts of data daily on cost, quality, safety, and other processes, and this data is generally stored to be the most disc space efficient. This means that this data is stored based on different organizational constraints and cannot easily be compared against one another. By utilizing big data analytics, Exelon and other organizations can benchmark a wider variety of key performance indicators over a longer period against a larger variety of organizations. Leveraging this new technology could prove a lucrative venture for Exelon in the long-term by unlocking trends previously unrealized in their current benchmarking process.

### **Reduce Additional Barriers to Success**

During the interview with [REDACTED], the group discussed many of the barriers to successful benchmarking, including overall costs, employee commitment, change management, and time constraints. Per [REDACTED], Exelon works to mitigate the effect of these barriers through a variety of

managerial techniques, but more effort can be put forth to minimize the greatest contributors to the difficulties of benchmarking. As discussed during the methods section, "time constraints" was ranked as the greatest problem in the benchmarking process for all the surveyed organizations. (Rogers et al., 1995) Currently, Exelon relies on strict scheduling to plan on-site or off-site visits for benchmarking, which occasionally end up rescheduled, cancelled, or altered due to these time constraints. Exelon can improve the scheduling process for these visits and dedicate specific personnel resources to benchmarking projects to ensure full-time availability. This would also allow the pursuit of additional benchmarking related projects during the time between site visits. Furthermore, instituting a change management program would improve the organization's ability to mitigate barriers caused by change resistance to process changes.

### ***Future of Exelon***

Exelon is always looking for ways to innovate both the energy industry as well as the organizational processes. Presently, Exelon is working to streamline their data collection systems to improve overall efficiency. As mentioned in the prior sections, Exelon benchmarks against data from a wide variety of sources, which can be a fragmented and complex process. This new system will improve Exelon's ability to benchmark against an assortment of industries by restructuring this process. In addition, organizations such as Exelon bear the brunt of environmental policy changes. Exelon attempts to stay ahead of these policies by continuously pursuing more environmentally-conscious opportunities per its vision for quality and innovation. According to Okon (2016), Exelon's subsidiary ComEd is considering expansion into renewable energy sources to compensate for the closure of two major nuclear plants in Clinton and the Quad Cities. It is unclear if the lack of legislative support for nuclear power in Illinois will cause the closure of additional plants in the future. Exelon relies on state subsidies to maintain

profitability across the six nuclear generating plants in Illinois. No matter the direction the next decade takes for Exelon, the organization will continue to utilize benchmarking methods for quality improvement.

### ***Lessons Learned***

Throughout the research process, the group researched the method of benchmarking thoroughly via academic sources, which was supplemented by the invaluable practical information from the Senior Reactor Operator at Exelon, [REDACTED]. Prior to engaging in this project, we were unaware of how integral benchmarking truly is to both Exelon as well as the greater Nuclear Industry. Benchmarking is the cornerstone of Exelon's continuous improvement strategy, and their highly customized method of benchmarking has helped them veer away from potential hazards, such as the water level control issue at the LaSalle plant. This methodology has allowed Exelon to always improve through monitoring competitor performance and generic best practices of other industries. Initially, the group imagined that for a highly competitive and regulated industry like nuclear power, the desire for competitive advantage over others in the marketplace would cause significant barriers to the benchmarking process. However, many of these power plants are involved in information exchange institutions and benchmarking coalitions that allow for key performance measures to be communicated across the industry. These coalitions help innovate within the industry as well as reduce the major cost barrier associated with pursuing a competitor's data.

Throughout the interview process, the group was able to apply the knowledge gained by studying the methodology to how Exelon specifically conducts their benchmarking procedures. For example, [REDACTED] explained to us the method of using Corrective Action Programs when benchmarking to standardize the process of gathering data, which integrates directly to the

assessment recommendations made by Voss et al. (1994). This interview also provided an industry example of how the different barriers researched by Rogers et al. (1995) can impact benchmarking in an organization as vast as Exelon. This process educated the group on how critical benchmarking can be to improving processes and innovation at both Exelon and other organizations.

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## Appendix A

**[REDACTED]**, Exelon: Interview Questions

Following are the interview questions and responses (**in bold**) for **[REDACTED]**, Senior Reactor Operator at Exelon:

1. Does Exelon use any of the following external sources to measure organizational performance? **Yes**. If so, please describe them.
  - a. Competitive Benchmarking (against primary competitors) **Exelon continuously perform Benchmarking against our competitors. Exelon reviews what our competition in the industry is doing better than us and reviews their processes to determine if there are improvements to be gained. Exelon often performs benchmarking at our competitors to evaluate new processes and or procedures to determine if the changes are a good fit for Exelon.**
  - b. Functional Benchmarking (against non-competitors) **Exelon benchmarks amongst itself to improve our refueling and online process. Exelon looks at which one of our sites performs the best at a certain process or stage of a refueling outage and has personnel from other sites benchmark that site to learn what it is that is making them better and what can their site and possibly other sites learn from the way they do business.**
  - c. Generic Benchmarking (generic exemplar practices) **Exelon benchmarks the Fire Protection/Prevention groups to make sure that we are complying with all the rules and regulations in place. Exelon also looks to these entities for innovations in tooling and equipment.**
2. How do the following barriers impact the ability to benchmark effectively at Exelon?
  - a. Cost of benchmarking: **The cost of benchmarking can be extensive, you must pay the person performing the benchmarking and at times pay someone to cover for that person, travel, meals, and lodging. Exelon works to set up benchmarking when it has the least impact on the people performing the benchmarking and those who must cover for them.**
  - b. Resources Scarcity: **There are some of the processes involved in operating a Nuclear Power Plant that can only be benchmarked at another Nuclear**

**Power Plant and depending on what is happening at those involved plants a benchmarking opportunity may not present itself.**

- c. Technical Expertise: **There are a large number of Nuclear sites, Technical Expertise is not an issue.**
  - d. Managerial Commitment: **There are times that the workload for an individual is too high for them to perform benchmarking. When this happens, the supervisor has options to deal with it, they can reschedule it, cancel it, or send an alternate, or they can create an action to verify that the person is provided the time to perform benchmarking.**
  - e. Employee Commitment/Change Management: **N/A**
  - f. Lack of training: **N/A**
  - g. Time Constraints: **Time constraints can be an issue on both sides, the place performing the activity that is desired to be benchmarked has a certain date to perform it and the Exelon person must be releasable from their site to observe and hopefully learn from the benchmarking.**
3. Have you noticed any additional hurdles that your organization has had to overcome due to benchmarking? If so, please describe them. **Exelon has not had to overcome any real Hurdles due to benchmarking, there are minor inconveniences, but those are easily outweighed by the sharing of information and knowing that there can and most likely will be a reciprocation in the future at a minimum, also the open exchange of knowledge builds bridges that can be used down the road for problem solving.**
  4. Data Envelopment Analysis is a widely used method for analyzing organizational efficiency when benchmarking. To what extent is this method used at Exelon? What are the major Decision-Making Units (DMUS) in the DEA data? Are these targets Local or Global? **Exelon does not use DEA or DMUS. We have a corporate Performance Improvement Procedure that guides the Benchmarking Assessment Process.**
  5. Another common method is the Ordinary Least Squared regression for benchmarking, often used to measure the value added to the electrical distribution network. Has Exelon utilized this model of analysis? If not, what other models are used to standardize the benchmarking process across departments? **No. Exelon performs quarterly performance assessments for routine performance monitoring by which station and department performance is**

assessed and analyzed to identify emerging performance gaps, and confirm progress on existing gaps that are being addressed through Performance Improvement Action Plans (PIAP). This process is also intended to self-assess performance as compared to the common industry standards established by INPO. PIAP's often drive benchmarking for the departments.

6. What are the key performance indicators used for benchmarking at Exelon? **CFAM indicators and projections, PIC indicators and projections, and business plan indicators.**
7. What methods are used for data collection and analysis in the benchmarking process? Has the improvement of technological data analysis simplified these methods? **Corrective Action Program (CAP), Trending, HU, Self-Assessment, Operating Experience, performance indicators, observations, leadership & team effectiveness performance trends. Yes, technology has help to simplify these methods.**
8. What are the common sources of secondary or external data at Exelon, and how is this data used in the analytical methods detailed above? **Secondary or external data comes from INOP, Fleet Assessment, WANO, NOS, and NRC. The data collected from these organizations is a presentation of station and unit information analyzed to provide early indication of potential declining performance. This allows sites to quickly identify areas of declining performance, and to benchmark performance against other locations.**
9. Researchers propose many methods for reducing internal and external data to improve the efficiency of the benchmarking process, including principle component analysis and exploratory factor analysis. To what extent does Exelon refine the data sources to improve the overall benchmarking process? What methods are most commonly used? **We take all information from these data sources to analysis our performance, but these are in the process of getting streamline.**
10. Have any major performance gaps been realized through benchmarking? **I am sure Exelon has found gaps thru benchmarking but not sure of them.** How did Exelon respond?
11. To what extent has benchmarking at Exelon been successful in realizing results in the following key areas: **Exelon works tirelessly at all of the factors and uses**

**benchmarking to improve in all of these areas and continuously works to attain excellence in Nuclear Power.**

- a. Quality Improvements:
  - b. Safety Measures:
  - c. Productivity Improvements:
  - d. Reduction of Waste:
  - e. Process Improvement:
12. Researchers theorize that while benchmarking studies can provide valuable links between performance indicators and the underlying problems within a process, many firms rely on inappropriate techniques to properly perform these studies and end up with biases and errors. Given the substantial cost of failure at Exelon, how does Exelon work to minimize bias and errors both in selecting the key performance indicators and the techniques for benchmarking? **Exelon has made efforts to perform benchmarking external to our industry to prevent bias to the nuclear industry. Performance indicators are reviewed yearly by site and corporate leaders to ensure criticality and standards are being met.**
  13. Can you give an example of a time at Exelon where a specific efficiency or safety target was met using benchmarking? **LaSalle was having too many reactor shutdowns due to reactor water level control issues, we benchmarked the industry and found a digital control system that could address our issues. We benchmarked the sites with the digital control system we believed would work the best for us and then spent time with the company at their development facility to work hand in hand with them to address our specific issues. We then installed the upgrade and have had almost zero reactor water level control shutdowns since.**
  14. Being a power plant, how much waste is being produced? And how could or has the company used benchmarking to reduce waste? **LaSalle site is considered a small quantity generator of waste. We have used improvements gained from benchmarking to improve our water processing by making changes to the plant which reduced our chemical and radioactive wastes, and we have removed packaging material before it enters the plant to minimize our dry active waste, this also allows us to recycle a large portion of our packaging materials.**

15. What kind of statistical methods do you use to calculate energy consumption? **Exelon looks at our energy consumption per site thru the various uses, i.e. lighting, vehicles, computers. We calculate the use of energy of these components and determine what improvements will provide the biggest reductions in energy use.** And how has benchmarking helped to decrease the overall energy consumption? **Exelon has benchmarked the “green housing” initiative across the country and is using learnings from them to retrofit lights to LED’s, smarter buildings with better insulation, automatic lighting, etc...**
16. In a journal there is said to be 4 priorities of Benchmarking, Strategic Importance, Ease of Benchmarking, Relative Impact on Business Economics, and perceived inability to improve. Out of the 4 which would be held most import for Exelon? **LaSalle performs benchmarking due to the perceived inability to improve i.e. if we are having trouble improving in a specific area we will benchmark a site that is the “Best” in that area to gather insight on areas for us to change the way we do business.**
17. In class we had learned about different quality control tools, with benchmarking what kind of tools does Exelon use? (the types of tools that were talking about in class: Flow Charts, Run Charts, Control Charts. Check Sheets, Histograms, Pareto Charts, Fishbone Diagrams, and Scatter Diagrams) **Benchmarks are procedurally guided to ensure quality control. Both the plan and final report must be approved by the Manager, using a Manager Plan Approval Check List and a Manager Report Approval Quality Check List.**
18. Many organizations choose to graphically identify benchmarking needs using an important-performance matrix, which identifies the most urgent and real problems. To what extent is this method used at Exelon? **Exelon uses Performance Indicators developed using input from various internal and external entities.** If it is not used, what would be considered the highest level of priority for benchmarking at Exelon?
19. Are there any processes at Exelon that may be considered both low importance to customers and low priority by upper management that you feel deserve a higher priority in benchmarking? **No, Exelon does a good job of benchmarking the important areas of our core business.**
20. It can be common for organizations to be hesitant to share information regarding their high-level processes. Is this a common trend in your sector, or is competitive analysis

commonly done among other companies? **Exelon is part of several large Nuclear information exchange institutions some of which are worldwide and we openly exchange information so others can learn from our processes which in exchange allows us to learn and improve from their processes.**

21. How are the findings of benchmarking studies communicated throughout the company's workforce? **The findings are communicated in various ways, sometimes they are sent out via an email, posted at the work sites, presented in training, or in work group discussions, the importance of the findings dictate how they are communicated.**
22. Senior leadership is imperative in leading the integration of better practices. Does Exelon's top-level management play a large role in continuously improving organizational performance? **Exelon's Senior Leadership drives improvement of our organization. The Senior Leadership Team oversees many improvement items and sponsors them as well. They are responsible for the organization's continuous improvement and making sure we are striving for excellence.**
23. One of the critical success factors in benchmarking is the commitment and vision of top level management. How would you rate the top-level management's level of involvement in the benchmarking process? **LaSalle's top-level management is very involved in making sure benchmarking occurs and if needed will help identify what the focus area is for the benchmarking.** What types of support and resources are provided by management to employees involved in the benchmarking process? **Exelon will arrange the benchmarking trip, provide relief for the individual and cover the expenses of the entire benchmarking process.**
24. Generally, the three criteria that companies identify that are necessary for continuous improvement are financials, customer satisfaction and process management. Which category seems to be the most frequently used as the focus for benchmarking efforts? **Process management would be the most frequently used benchmarking effort, but that can be directly tied to financials, should the benchmarking provide an improvement in process that could save time or effort which in turn leads to money savings.**
25. Many organizations follow a template for benchmarking within the organization, generally beginning with a performance assessment, identification of performance indicators and

benchmarking partners, and ending with the company specific analytical benchmarking methodology. Does Exelon provide a template for benchmarking, and if so, what are the general steps? **Exelon does provide a template for benchmarking, it is a form available to anyone to use. The general steps are Purpose of the benchmark, results which include recommendations, deficiencies, and actions based on findings, a summary of the benchmark and documentation of documents that may have been reviewed, people interviewed, team involved, and then who should receive the information from the benchmarking.** If not, do you find a lack of a template leads to any issues with standardization in the benchmarking process?