Monitoring Safety Process Performance with Leading Indicator Safety Audits

A thesis presented to

the faculty of

the Russ College of Engineering and Technology of Ohio University

In partial fulfillment

of the requirements for the degree

Master of Science

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August 2015

This thesis titled

Monitoring Safety Process Performance with Leading Indicator Safety Audits

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ABSTRACT

VAN BIBBER, ASHLEY M., M.S., August 2015,

Industrial and Systems Engineering

Monitoring Safety Process Performance with Leading Indicator Safety Audits

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Safety professionals are constantly striving to improve safety in the workplace and achieve the ultimate zero incident goal. Easy fixes and implementations are the first lines of attempt to work towards that goal. Over time, greater commitments and investments into continuous improvement will be necessary to maintain a higher level of performance and expectations within a safety program. Lagging indicators have long been used in safety as a measure of success. These indicators provide cost data and information about an injury or illness after it has occurred. However, this information can only provide knowledge of the effects or evidence of an injury. Leading indicators are specific items that can potentially explain or predict the possibility of a future incident. General research and information on leading indicators has been seen in occupational safety and health research in the past decade, with case studies only starting to appear within the last five years.

The object of this study was to develop safety audits around leading indicators selected from past incident reports and monitor the performance of the key indicators selected at two dining halls at a large Midwestern university. Risk awareness assessments were distributed to full-time staff to study personal perceptions of risks in the work environment. Additionally, toolbox talks were conducted at staff meetings in an attempt to connect safety processes to personal perceptions of risk.

Results indicated a statistically significant difference in the safety process performance between the two dining halls. Data from the safety audits were plotted on I-MR control charts. Control charts indicated out of control points for

certain indicators in areas of the dining halls, which can demonstrate the increased risk of injury. Patterns in the control charts across multiple areas in one dining hall revealed an inventory control issue. The second dining hall experienced a safety behavior issue that was confirmed with information from the risk awareness assessments, but was not able to be monitored with the safety audits. This finding suggests the need for a lasting relationship with employees also, as safety audits may not be as successful with capturing safety-related behaviors.

DEDICATION

To my Mom & Dad, I could never thank you enough for your unconditional love and never-ending support throughout my life.

To Tyler, for always believing in me, never doubting my abilities and being my better-half.

To Dr. Brian Hoyt, for instilling passion in me to work hard, be the best, and to never have excuses because there are always 24 hours in a day. Most important of all is the ability to get work done with and through people to reach organizational objectives in a dynamic environment with scarcity of resources as measured by and within the parameters of effectiveness and efficiency.

ACKNOWLEDGEMENTS

I would like to thank my advisor Dr. Diana Schwerha for all of her assistance throughout the completion of this thesis. Without her continuous advice, positive encouragement, and though provoking questions this thesis may not have been achieved. I would also like to thank Jeff Campbell from the Environmental, Health, and Safety Department at Ohio University. His positive support, guidance, and personal mentoring in the Occupational Safety field contributed not only to my development as a safety professional, but also to the completion of this thesis. His never-ending reminders of the satisfaction the completion of this work would bring truly helped me press onward with my research. Lastly, I would like to thank my thesis committee Dr. Ryan, Dr. Weckman, and Dr. Masel for their time, support and input related to my research.

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CHAPTER 1: INTRODUCTION

Safety professionals are constantly searching for ways to improve safety and health in the work environment, reduce incidents, and reduce costs resulting from safety-related incidents. There were 918,700 recordable cases of injury or illness that required time away from work across the United States in 2012, with 54,430 cases coming from the food service and drinking industry (United States Department of Labor, 2012).

Organizations often pick the "low hanging fruit" when first attempting to solve issues relating to safety and health. They are easy fixes and sometimes do not require a lot of investment. These often include posting signs to remind staff of safety procedures or common hazards, incorporating refresher training after a certain amount of time from the initial training, and incorporating safety information into existing weekly or monthly meetings. Eventually, improvements will plateau with the simple changes and a greater level of thought, investment, and commitment will be required by the organization to achieve greater improvements.

Additionally, safety professionals can decrease incident rates, improve employee morale (Schiava, 2014), and can make safety an integral part of an organization's strategic goals by using leading indicators. Continued analysis and data collection of safety metrics in a work environment can lead to an abundance of data. Data must be focused to key indicators that will allow safety professionals enough data to make intelligent decisions about deficiencies and needed improvement areas, but not too much data so that a view of the current state is obscured; lagging and leading indicators are one such way to do so.

Lagging indicators, many of which are required by Occupational Safety and Health Administration (OSHA), provide information on the aftermath or effects of an injury or illness that has already occurred. Incident rates, lost time incidents, Experience Modification Rate (EMR), and workers' compensation costs are all examples of lagging indicators. When improvements or changes are implemented into a system, lagging indicators provide a baseline to which to

compare a future state (La Duke, 2010). It is a growing realization in the occupational safety and health field that past performance is a poor predictor of future performance (La Duke, 2010). The simple fact that an organization may not have had a lost time incident for the past 3 years does not diminish the risk for an incident in the coming days. To simply rely on past performance indicators is not enough to ensure employees are working in a safe environment. Thus, the concept of leading indicators has started to grow in the past decade.

Leading indicators are a condition, event, or measure that could potentially predict or explain the possibility of a future injury, illness, or fatality (Hinze, Thurman, & Wehle, 2013): Indicators include the number and state of personal protective equipment (PPE), how many employees have completed OSHA training, the number of individuals who pass a drug test, or how much overtime employees are working. Leading indicators should be designed to link with future planned actions to reduce the potential for incidents. The novelty of leading indicators still presents many challenges because of the inexperience and lack of research of their use. Some organizations have successfully used leading indicators, while others seem unable to identify an efficient way to implement them. Safety audits may be the best possible technique to capture and monitor all leading indicators at once, as they allow an individual to perform a walkthrough of the work environment and monitor the most necessary information relative to potential incidents and risk (Hakkinen, 1999; Schiava, 2014).

Research shows a mutual agreement among safety professionals that leading indicators can be used successfully in a safety program, but the challenges presented may differ across industries. Hinze (2013) suggests indicators differ across industries, especially with construction, but that the measures can also differ within phases of a project. Such analytics may be a new topic for safety professionals, especially within smaller companies with limited resources, and present difficulties not only for interpretation of statistical analysis, but also how to collect data in an objective and accurate manner (Manuele,

2009). Additionally, there is no sound or established methodology or mathematical model to decide on the most important leading indicators, and then translate those identified deficiencies into sound actions and improvement activities (Manuele, 2009).

The objective of this study is to develop a methodology that will:

1.) Support the development of customized safety audits and leading indicators at the process level, and;

2.) Increase risk awareness at the personal level.

Specific objectives include:

1.) Safety audits will be created through a process that includes using leading indicators and used to assess and monitor the safety processes in a work environment;

2.) Toolbox talks addressed the leading indicator deficiencies presented by the safety audit results;

3.) Risk Awareness assessed with pre- and post-risk awareness assessments, with the pre-assessment given before the safety audits and toolbox talks were performed and the post-assessment given after the last toolbox talk.

Data collected from this study will be used to test the following hypotheses:

As toolbox talks are used to address low performance of leading indicators, employee risk awareness should increase due to the attention and focus the toolbox talks will bring to such issues in the work environment.

H_1 = Personal risk awareness in employees will increase after toolbox talks are conducted.

As safety audits and toolbox talks are conducted, it is predicted that the level of performance in the safety processes will improve as compared to the performance before said safety audits and toolbox talks were conducted.

H_2 = Performance of safety processes (safety audit scores) will increase after the introduction of toolbox talks and continued use of safety audits.

CHAPTER 2: LITERATURE REVIEW

2.1 Using Indicators to Monitor Safety Behaviors and Processes

2.1.1 Utilizing Metrics and Indicators from a Safety Industry Perspective

Metrics are used across industries and in various departments and settings. They are used to define a baseline for the performance of a system, monitor its existing and future states, and to visually demonstrate the effects of any changes implemented (Carson & Snowden, 2010). La Duke (2010) provides the following three guidelines when using metrics to monitor safety: keep them simple and direct; be aware of unintentional effects and consequences resulting from monitoring items, such as the Hawthorne Effect; and have defined operational outcomes to which the metrics can be linked. These three rules for applying indicators can also be generalized across industries and areas. Occupational Safety and Health professionals hold some uncertainties in mind with the appropriate way to implement indicators in a way that will deem their investment successful.

Indicators can be useful in their ability to help drive performance, make sound business decisions in an objective manner (Carson & Snowden, 2010), and monitor the variation in a system. Safety professionals are always striving for goals in their safety programs, such as working towards zero injuries or lost time incidents, lowering worker's compensation costs, and improving worker morale. In order to continue this process of continuous improvement, measurement of safety performance and processes should be in place. A solution to a safety concern cannot be solved effectively and accurately with qualitative data alone; the need for quantitative data is as essential as the presence of qualitative data. Return on investment is a simple justification as to why additional resources should be allocated for additional data collection and utilization. Research not only shows a return on investment for every dollar invested into improving a safety program, but also an increase in employee well-being, productivity, and an overall attitude towards safety policies ("Safety first," 2014).

Lagging indicators provide information on events that have already occurred, while leading indicators provide predictive information. The implementation and use of such indicators in Occupational Safety and Health has presented difficulties for safety professionals across the board. At this point in time, there are no established best practices for selecting, monitoring, and connecting leading indicators to tangible outcomes in an organization (Manuele, 2009). The foundational knowledge that indicators, leading and lagging, are useful exists, but the gap on how to carry out this process is apparent in the field of research. Manuele (2009) also discusses the criticism safety professionals receive because they have incomplete methodological approaches to monitor and make intelligent decisions with quantitative safety data.

In another aspect, many levels of organizations use data to justify allocation of resources. Safety professionals need to quantify and demonstrate performance and expectations of safety programs to be considered a contributing factor to the success, or failure, of an organization. A poor performing safety program can cost an organization thousands of dollars in direct and indirect costs, especially in cases where death is the result of an incident. Organizations can find themselves paying up to $70,000 for a safety violation (Adams, 2003; OSHA, 1970), while OSHA reports that across the nation organizations annually spend $170 billion dollars on occupational injuries and illnesses ("Safety first," 2014). If an intervention is needed to improve safety, whether it be for personal protective equipment (PPE), specialized training, or hiring additional safety staff, the request will never be heard by upper management if there is no tangible proof to support the spoken needs (La Duke, 2010).

2.1.2 Lagging Indicators

Lagging indicators provide information about an event that has already occurred. These indicators can also be used in terms of assessing a process change, as a lagging indicator can convey whether an implemented change has been successful or not relative to a predetermined goal (Manuele, 2009). Lagging indicators are required by many government agencies and include

recordkeeping items required by OSHA. Days Away or Restricted Time (DART) rate, incident rates, Lost Workday to Injury (LWDI) are just a few of the items required by OSHA and also considered lagging indicators (La Duke, 2010). They can also include near misses, though near misses have begun to be considered as either a leading or lagging indicator (Hinze et al., 2013).

Lagging indicators are beneficial as they provide the baseline status of a safety program, but do have limitations concerning the amount of information that is conveyed (La Duke, 2010). There is no explanation, either causation or contribution, as to why an incident occurs (Hinze et al., 2013). Even though the amount of information provided by lagging indicators is limited, they are still critical. They can be used to assess and confirm the effects of an implemented process change, to identify possible areas of improvement, and prioritize needed change (Carson & Snowden, 2010). With the growing presence of leading indicators, the value of lagging indicators is being scrutinized by the industry. They should not be valued less because of their ability to provide a limited amount of information; it is merely a different type of information provided. Lagging indicators are more reactive in their focus, while leading indicators are proactive – preventing incidents before the next one occurs (Hinze et al., 2013).

La Duke's (2010) suggestion to watch for unintended consequences should be considered when lagging indicators are being monitored. The type of data that lagging indicators include are measures that are sometimes viewed as criminal and carry with them a bad reputation. Hinze et al. (2013) discusses a study where near misses were used as a lagging indicator and employee perceptions of lagging indicators and near misses influenced them to underreport close calls. This caused the data to present an assumption that the worksite was safer than it truly was. It is important to stress to employees the importance of accurate and unbiased reporting in such cases, and to assure them no repercussions will happen to those who report.

2.1.3 Leading Indicators

Leading indicators are being used as predictors of future events and performance, but are also described as conditions, unsafe behaviors, or measures that will precede an incident or unsafe condition and has predictive value in that regard (Hinze et al., 2013). The number of training hours completed, how many managers attend safety meetings, percentage of workers observed performing safe behavior, how many employees and managers have completed OSHA certifications, and the number of negative drug test results can all be labeled and used as leading indicators. For organizations to improve their incident rate, they must know where and what to improve in the safety processes (Manuele, 2009) or how to address employee behavior. Leading indicators provide bits of information about items that may contribute to an incident occurrence; leading indicators are the change that can be witnessed in the lagging indicators. Thus, leading indicators can be linked to activities that will improve the state of lagging indicators (La Duke, 2010).

2.1.4 Current Challenges in Using Leading and Lagging Indicators

Leading indicator use is still developing and being studied, and with that presents challenges for safety professionals wishing to implement both leading and lagging indicators due to the lack of established best practices. Currently, no mathematical or scientific model has been established for an organization to base selection of leading indicators on (Hinze et al., 2013). Thus, it will require a greater level of dedication from an organization to carefully choose, monitor, and adjust the indicators in question. There may never be an established set of rules to select indicators because of the individuality of safety programs between companies and across industries. The importance and criticality of certain indicators can differ across industries and single method for their selection may not accurately apply to all. Hinze et al. (2013) reviewed the concept of leading indicators evolving between and throughout phases of a project, and suggested that indicators will need adjusting throughout the life of the project. Indicators that may be a priority at one stage may be non-existent at another. For example, the

tracking of fall protection PPE and training would be useless at the groundbreaking stage of a construction project, but critical during the final stages when roofers are plentiful on the job site.

For some, the belief that more leading indicators is better may become commonplace (La Duke, 2010), and is a risky plan to follow. The assumption leads to wasted resources, time and effort, on measurable items that may be completely irrelevant to reducing incidents or addressing unsafe behavior. It would be more strategic to have a few meaningful indicators rather than a hit-or-miss approach.

Other challenges to using leading and lagging indicators include using a safety incentive system and focusing on only quantitative or qualitative data (La Duke, 2010). A safety incentive system encourages employees to underreport, or in some cases over report, injuries or other items being measured. This issue of false reporting skews data and creates a false representation of the safety environment. Focusing on only quantitative or qualitative data can also cause the same issues with employees selectively reporting. In his article "The Changing Face of Safety Measurement," La Duke (2010) presents one case study in a call center where only quantitative data, the length of a service call, was being collected. Eventually, call center employees were hanging up on customers in order to record quicker call times; however, customer satisfaction ratings quickly decreased due to the organization's subliminal message it was portraying to employees by only focusing on one metric.

2.2 Safety Audits

2.2.1 Using Safety Audits as a Leading Indicator

Safety audits can be used to monitor safety-related behaviors, as well as safety processes, or unsafe conditions (Schiava, 2014). They have the ability to provide meaningful information on several levels at once: PPE, ergonomics, observations, conversations with employees, or housekeeping, and identify on-the-spot at-risk behaviors (Schiava, 2014). Research has suggested that a safety audit can be labeled as the singular most important tool when tracking leading

indicators because it encompasses all items into a single format. Additionally, research at Carnegie Mellon University (CMU) found that information derived from safety audits and observations can explain up to 75% of the variation in the frequency of occurrence in occupational injuries (Schultz, 2014).

Audit results and scores can be collected and tracked over time to find items or results that have a downward trend. The results that continuously fail, or have a greater degree of variation, are indicators of a possible future incident (Powell, 2012). Trending audit results are more aligned with the proactive approach of leading indicators, as compared to the reactive approach of lagging indicators. Tracking the correction of physical items found to be defective or a failure during a safety audit should also be considered a worthy safety-related activity. Having management commit to the tracking and correcting of defective equipment creates accountability for safety at multiple levels in an organization. Tracking activities decreases the possibility of future injuries and builds employee trust in management as they see tangible improvements from auditing activities (Powell, 2012).

Schiava (2014) discussed a case study from The Boston Globe where observational safety audits were implemented. There was a major issue of over reporting of incidents, and the company was battling high claims and workers' compensation costs. The goal was to improve employees' focus and outlook on safety, and to ensure the workforce that safety was a primary concern from the top to the bottom of the organization. The company's invested focus on safety proved successful, as they gained considerably positive results by 2010, eight years after he initial start of the safety audit initiative. The following are the results from The Boston Globe's safety audit program: A 75% decrease in work-related incidents, 85% reduction in loss-time incidents, musculoskeletal disorders (MSDs) reduced by 85%, and workers' compensation costs were reduced to $1 million per year from a previous $6 million per year (Schiava, 2014).

2.2.2 Assessing Safety Behavior & Process Safety with an Audit Tool

Audits can be a valuable tool for an organization because of their ability to be customized. They should not be the core of a safety and health program, but a supplementary tool to aid in identifying unsafe conditions, at-risk behavior, and root causes (Hakkinen, 1999). An audit should be designed with focused attention and insight into an organization's own processes and operations. Many ready-to-print audit tools exist online, but to gain the most from an auditing tool program, audits should be custom designed (Huang & Brubaker, 2006). Using historical data from past incident reports or performance of processes in relation to safety can provide clues on where to focus audit efforts (Torres, 2007). By customizing an audit specifically for an organization, department, or area, the information gathered from the auditing process will provide meaningful information to those who collect and use the data to make intelligent decisions.

According to Hakkinen (1999), safety audits are best used for focusing on policies and work procedures in the present, and do not take into consideration past or future activities. Audits provide information that can be viewed as a snapshot of the current state of processes and performance. Other types of analysis include risk analysis, which is better suited for looking to the future, and accident analysis which looks at historical information (Hakkinen, 1999). Of the three types of safety analyses (risk analysis, accident analysis, and safety auditing), auditing is the one that can be most widely applied in any type of industrial safety incident, whether it be for an injury, a fire or explosion, or even a large scale catastrophe (Hakkinen, 1999). The broad application of the safety audit makes its implementation appealing because of its potential to be used in a variety of situations. Once resources have been dedicated to its continued use, it can be valuable in a variety of ways to an organization.

Issues with safety audits do exist, and their content must be thoroughly examined. It is easy for audits to focus only on a health and safety program as a holistic approach and miss the opportunity to examine details in specific processes. In this instance, details or a failsafe intended to keep individuals safe

may be overlooked in the auditing process (Eames, 2013). From this explanation, it is encouraged of audit users to be suspicious of audits that yield 100% compliance. This result would suggest the audit design is not focused enough, and the auditor needs to be retrained on identifying hazards and unsafe behavior, or existing issues with the worksite. It is not uncommon to see worksites with 100% compliance audit scores have reoccurring incidents. One explanation for this is that management and/or employees may be specifically preparing for the audit process, and then not carrying out safety rules at all other times on the worksite. Huang (2006) even goes as far to suggest that the reliability and validity of an audit needs to be assessed before it should be used to monitor processes and behavior.

2.2.3 The Influence of Safety Audits on Employee Behavior

Many organizations claim that safety audits improve safety behaviors and decrease incident rates. Research mostly supports this claim, but some studies discover differing results. One study sought to investigate the relationship between the number of training hours, disciplinary actions, and safety audits on incident rates, including total recordable incident rates and lost time incidents. The study's results showed a relationship between organizations' total recordable incident rate and safety audits, but only in participants that performed 21 or more audits in one year (Brahmasrene & Smith, 2009). However, this finding of statistically significant associations between incident rates could not be extended to the number of training hours employees received and the first two instances of disciplinary actions employees received after safety violations had occurred (Brahmasrene & Smith, 2009); in other words, at the third disciplinary action employees received, their behavior changed in a manner that positively affected incident rates.

In contrast to the findings of Brahmasrene & Smith's (2009) study, Agraz-boeneker, Groves, & Haight (2007) found no statistical relationship between auditing observations and safety behaviors. These differences in findings are interesting due to their conflicting results. The findings suggest more complex

factors may play into the motivation and changing of employee behavior than the simple act of just conducting audits. The studies do not elaborate on specifics of the age, experience, or position of the participants, as well as the industry or worksite used to evaluate the effects of auditing on safety behaviors. The act of auditing processes and behaviors must be tailored to the specific worksite and employees; in this case cookie-cutter programs may yield unsuccessful results.

Possibly one of the most obvious and effective ways to reduce incidents and change employee behavior is to include and inform the workforce of the auditing process. DuPont found that of their company's injuries, four percent were due to unsafe conditions while ninety-six percent were due to an unsafe behavior (Torres, 2007). Assuming this finding can be applied across industries or organizations, the involvement and focus on recognizing behaviors can significantly reduce the potential for injuries. The presence of unsafe conditions cannot always be completely eradicated in the workplace; therefore, emphasis should be placed on correcting bad behaviors and reinforcing good behaviors during the audit process, allowing the audit process to have a focus on people (Johnson, 2012). Discussions with employees about audit results can keep them informed of findings, build trust between management and employees, and encourage employees to think about their behavior while at work (Johnson, 2012; Torres, 2007).

2.2.4 Tracking Safety Process Performance

Safety professionals are often limited in the terms of how they may voice the state of performance in relation to safety in the workplace. Injury and death rates, workers compensation claims and costs, and Experience Modification Rate (EMR) are all available to express the state of performance, but these items are all lagging indicators. The ability to track and monitor leading indicators can provide important information as to the performance of specific occupational safety indicators in the workplace that are directly associated with those previously stated lagging indicators. Simply tracking indicator performance is not enough, though, the ability to make sound business decisions based on

performance is vitally important for occupational safety to be a success in an organization. One such way to do so is to use control charts, which can also demonstrate statistical significance and proof of changes or shifts in performance levels.

In the mid-2000s, articles and periodicals introducing the implementation of control charts and six sigma quality-based tools for safety performance items are mostly seen in the literature ("A Case Study : Six Sigma Tool Usage," 2005, "Constructing a Control Chart (U-Chart) for Injury Rates," 2006; Prevetta, 2006; Williamsen, 2005). Many articles offered basic information on what six sigma quality tools were, such as control charts, cause and effect diagrams, and Pareto charts, and their basic use and implementation design. However, it must be noted that although quality tools can be used to monitor safety related process, they must be revised to fit safety needs as they were not originally designed to be used for safety processes.

It has only been recently, within the past 5 years, that case studies have started to emerge in the literature where companies and researchers have started to implement six sigma tools and methods to improve safety processes (Ateekh-ur-Rehman, 2012; Hu & Qu, 2014; Larsson, Landstad, Wiklund, & Vinberg, 2011; Lokkerbol, Schotman, & Does, 2012). Hu & Qu (2014) used statistical process control (SPC) charts to identify and validate variables by detecting abnormal changes, or special causes, in participants' gait to determine when a slip or fall would occur. Five indicators were chosen based on their ability to indicate when a fall was imminent. The indicator control charts were implemented to provide real time data so that when a strong enough variation occurred, it would simultaneously trigger a fall protection device to provide extra protection for the individual (Hu & Qu, 2014).

As a more general workplace safety implementation, Larsson et al., (2011) developed a warning system for overall worker health within an organization. Questionnaires were developed for employees to complete every day for eight weeks so perceptions of their general health could be collected and turned into

control charts. As a comparison, actual employee sick day indicators were used to create control charts to determine if how an employee was feeling could be mapped with expected sick days while also looking at other factors being monitored in the work environment (i.e. amount of overtime, workload) (Larsson et al., 2011)

2.3 Risk and Hazard Awareness in the Workplace

2.3.1 Risk Perception

All work environments present a level of risks and hazards to be controlled and identified. Some industries exhibit a higher level of danger than others: mining, off-shore drilling, and the construction industry are some of the most dangerous industries in relation to occupational safety. To generalize, there are two sides to safety: the presence of unsafe acts and unsafe conditions. The unsafe conditions can be controlled with the use of elements such as process design, personal protective equipment (PPE), and safety policies. Unsafe acts can be more challenging to control and maintain.

When working with occupational safety hazards, there are three major areas to consider and control related to risk: risk identification, risk assessment, and risk control (Elefterie, 2012). Risks in the environment must be identified through their likelihood of occurrence and the severity with which they occur, then assessed using a safety audit, and finally controlled to minimize the occurrence and severity of the hazardous situation (Elefterie, 2012). Risk perception itself is situation specific and can vary from person to person (Floyd & Floyd II, 2014). Those with low risk perception often fail to participate in protective behaviors because they see no need to, while those with high risk perceptions often embrace cautionary measures and behavior ((Floyd & Floyd II, 2014).

2.3.2 The Connection between Risk Perception and Risk Behavior

Unsafe acts can be difficult to manage due to the individual nature of each employee and the situation they may find themselves in. Management can purchase an adequate amount of PPE, but employees can still make the mental

decision to not use it. This decision can be based on many reasons and may be different for each employee. How employees perceive the risk in their jobs and work environment may influence how they ultimately rate the risk and how they will respond to it (Rundmo, 1996). When employees have an unrealistic view of the true risk level, it may lead to bad decision making and cause a situation to become a threat to the worker's safety and health. Risk perception can be defined as the assessment or judgment that workers create based on assigned work tasks (Hallowell, 2010).

Research indicates many different factors can influence risk perception and awareness. Just as leading indicators can differ between industries and even organizations, the same concept may also apply to risk awareness. Hallowell (2010) discusses previous research that has identified contributing factors in risk perception that can be attributed to job titles, time of shift, and compensation levels. Alternatively, Rundmo (1996) found that employees who had experienced a previous injury were more likely to feel unsafe in the work environment. Employees who felt unsafe experienced higher stress levels which led to riskier behaviors. The study's results claimed that risk perception and risky behavior are associated, but that risk perception does not directly predict risky behavior. The identified intermediate factor, work stress, is the effect of perceived risk and affects risk behavior.

2.3.3 Situation Awareness

Endsley (1995) developed the situation awareness (SA) model in the mid-1990s which attempts to explain decision making and factors, including a dynamic environment, that influence such processes. The SA model describes the process of how individuals will evaluate a situation, based on items they deem relevant in their environment, and then formulate a level of awareness about the current situation. This evaluation influences how and what decision will be made (Endsley, 1995), and further what actual behavior may occur from the decision. Factors that may influence situation awareness assessment include the

amount of training the employee has received, experience, age, and task-related elements such as complexity of task, workload, and stress (Endsley, 1995).

Situation awareness (SA) can be more simply explained using three levels. The first level is perception of the environment; second is the comprehension of the items perceived in relation to set goals or tasks; level three is prediction of how current actions will affect future progress and objectives (Morita & Burns, 2011). Furthermore, the SA model can be used to assess employees' currently perceived level of risk compared to actual levels of risk present. Morita & Burns' (2011) research showed that situation awareness and safety can be directly related; as risk awareness is increased in employees' perceptions, safety culture is more prominent and a greater priority. Situation awareness could also be used as an explanation for why some organizations have issues with high incident rates. As workers fight to allocate mental and physical effort during tasks, they must also meet production demands and stress associated with meeting those demands (Naderpour, Lu, & Zhang, 2014).

2.4 Safety Training in the Workplace

2.4.1 Safety Training Effectiveness

Training, especially safety training, can be a difficult item to implement. All workers are trained on how to do their jobs correctly, but at times effective safety training can be placed as a low priority relative to other mandatory training. Finding effective safety training programs can be difficult; the amount of regulations employees must comply with and the challenge of stressing the importance of safety to employees are two key challenges.

There are three major inadequacies with safety training, and largely training programs in general: training is not conducted; training is not effective; training is conducted and designed well, but is not taught in a manner that can be transferred well into the work environment (Blair, Seo, 2007). Training transfer is a common issue and concern when trying to create an effective training program. Training is also a commonly-used justification for high incident rates or is used when person-blaming is common in an organization. Instead of researching a

root cause and focusing on process issues that may be contributing to occurring incidents, a refresher training or disciplinary course is taken and a behavioral fault is assumed. In this instance overtraining and irrelevant training becomes an issue (Blair & Seo, 2007). Most management assumes that training will automatically influence and increase positive behavior, attitudes, and decisions, but this is not the case. Training content and delivery must be planned, as well as training transfer, which takes place after training has been completed (Blair & Seo, 2007).

2.4.2 Training Transfer for Safety Training

Research has suggested that management's commitment to safety is just as critical as safety training for employees to be enthusiastic about a safety culture, achieve and maintain training transfer, and perceive risks realistically and consciously (Bush et al., 2009; Huang et al., 2012a, 2012b). Three main factors must be considered and planned to have successful training transfer take place: trainee characteristics, such as motivation to learn, integration of training into the workplace, and personal career commitment; training design; and work climate (Brinia & Efstathiou, 2012). When employees share a positive perception of an organization's training, the individuals in the organization create a shared view of safety as a group (Huang et al., 2012a). A strong view of safety training also positively contributes to an organization's safety climate. Safety climate and employees' perceptions of management's commitment to safety have been negatively correlated with the injury rates, safety compliance, and safety participation in organizations (Huang et al., 2012a). Training can be difficult to execute properly, but if conducted correctly, it can positively contribute to how employees and management perceive the importance and commitment to safety in an organization. This, in turn, can lead to reduction in injuries and cost savings for companies.

2.4.3 Safety Training Methods

In a study with restaurant supervisors and their employees, a training transfer study was completed that yielded conclusions suggesting the inclusion of

employees' decisions and participation in training modules is more successful than simply reading material and taking training tests (Bush et al., 2009). Restaurant supervisors explicitly said that interactive short training workshops would be more beneficial for a restaurant environment; such a suggestion follows the format of a toolbox talk.

Toolbox talks have been commonly used in the construction industry, but they could be used in other industries. Toolbox talks (TBT) are informal talks that are usually five to thirty minutes in length that can cover a variety of topics. The talks are designed to be two-way communication where employees can discuss the topic with management or the safety professional, ask questions, and prompt feedback about current performance (Allford & Carson, 2011). In the past few years TBTs have become more popular for education of occupational safety topics. The delivery and use of toolbox talks can offer many advantages such as the informality of dispersing information, building safety culture, and building trust between employees, management, and safety professionals (Allford & Carson, 2011).

CHAPTER 3: METHODOLOGY

3.1 Study Population

Participants in this study included employees at two dining halls at a large Midwestern university. Employees' ages ranged from eighteen years old to those in their sixties. In this diverse and dynamic environment of preparing and serving food, there are injuries common to this busy restaurant type setting. Slips, trips, falls, cuts/lacerations, burns, and musculoskeletal disorders (including strains and sprains) are very common injuries for the food service industry (Jones, 2011; Personick, 1991). It should be noted that participants were not compensated for their time and participated on an informed-consent basis. The study was approved by the Ohio University IRB as exempt.

3.2 Safety Audit Design

Safety Audits were developed analyzing past incident reports as well as preliminary walkthroughs and investigations of the dining halls. This initial examination aided in the development of a focused safety audit that was customized to the dining halls and allowed the audits to collect critical information that may be predictive of future injuries. Furthermore, the items found on the safety audits were tested as leading indicators and used to select toolbox talk topics. Safety audit scores were compared before and after the toolbox talks were given. The leading indicators were chosen to capture variation and errors in items that occurred in processes in the working environment. These deficiencies can be identified and improved to reduce the possibility of potential injuries. Traditional safety inspection items were included on the audit, such as fire extinguishers, exit signs, and safety signage.

Incident reports were reviewed for the 2014 year and relevant data collected and organized from the reports. Past incident data was coded and organized based on the coding method utilized by the Bureau of Labor Statistics. Injuries and incidents were coded using four categories: nature of injury, part of body, event/exposure, and source. A preliminary walkthrough of the dining halls was conducted to understand sources, levels of exposure, and overall design of

the work environment to understand factors that may have been contributing to the occurrence of incidents.

Based on the incident reports for the two dining halls where data collection took place, the following items were most common in the incident reports. Most of the incidents that occurred in dining hall A and B involved employees in the 20-24 age range. Arms (12.8%), hands (36.2%), and multiple parts of the body (14.9%) were signaled as the parts of the body most involved in injuries in terms of frequency. For the event/exposure category, struck by/against an object (49%), falls on the same level (17.0%), overexertion (8.5%), and exposure to harmful substances (8.5%), respectively, were the most commonly occurring injury events. Lastly, bruises/contusions (21.3%), cuts/lacerations (17.0%), soreness/pain (17.0%), and thermal burns (14.9%) were the most frequently occurring type of injuries. These factors were viewed as a significant when formulating leading indicators, which the audits were designed to monitor. The types of injuries occurring in the dining halls correlate with what the BLS reports for injury types in the food service and drinking industry.

Safety audits were conducted randomly Monday through Friday at two dining halls for five weeks (January 20th, 2015 to February 20th, 2015). A random number generator was used to determine the day and time of each audit conducted. A total of 30 audits were conducted over the course of the five weeks.

A status report for each conducted safety audit was returned to dining hall management. The audit reports included an overall audit score, a score for each sub-area inspected, and indicator scores for each sub-area on the detailed audit reports. Any positive or negative observations that were seen during the audit process were also included on the reports. The audit reports were designed as an objective snapshot that informed management of the current state of the environment at that time and were not intended to place blame on specific persons or operating procedures. An immediate follow up item list was included with each audit report if items were observed during the audit that required immediate attention (i.e. electrical cords that needed replaced, broken

equipment, fire exits or extinguishers being blocked by equipment). Summary audit reports were sent weekly to management, while detailed reports were sent upon request. Follow up items were used to reconnect with management about the performance and progress of the dining hall and any major issues that needed to be taken care of.

3.3 Toolbox Talks Design

The toolbox talks (TBT) were based on issues and procedures unique to the dining hall environment; therefore, they were completely customized to encourage a greater connection between the training material and the employees' experiences and knowledge. Any major issues, behavior or process, found within the environment during a safety audit inspection was recorded and considered as a topic for one of the two toolbox talks to be conducted. Research on training transfer and the theory of planned behavior was consulted during the design of the toolbox talks to ensure the training was designed for a high rate of acceptance by employees and to encourage the transfer of training. Toolbox talks are designed to be active learning by including participants in short activities or opening a two-way conversation between management and employees to allow employees to offer insight to hidden problems or possible solutions to daily issues.

Two toolbox talks were conducted during the study. The original timeline included conducting one TBT during the week of January 19th, 2015, and one during the week of February 2nd, 2015. This planned schedule would allow for two weeks of monitoring employees' behavior after the toolbox talks had been delivered to the staff. Two weeks between talks allows the information to stay relevant to employees' and their daily work, but not so much time that the information becomes dated by employee perception; toolbox talks are meant to discuss and raise current issues, thus topics would need to change with some frequency.

Due to scheduling conflicts and miscommunication with dining hall management, the two toolbox talks were not delivered to staff per the original

timeline. The toolbox talks were conducted during the weeks of January 26th, 2015 and February 16th, 2015. The TBTs were delivered to the staff during regular bi-weekly meetings that management schedules to cover current topics and safety information. The talks were approximately 5 to 15 minutes long and delivered by management so as not to disrupt the employee – management relationship. The first toolbox talk topics was on lifting safely and the second on unsafe conditions and unsafe acts in the workplace. Safety audits were continued during and following the weeks that toolbox talks were delivered in order to monitor for a change in the working environment that may have been caused by the toolbox talk training.

3.4 Risk Awareness Assessment Design

Two risk awareness assessments were distributed to the employees on the following dates: a pre-assessment was given during the week of January 19th, 2015, and a post-assessment was given during the week of February 23rd, 2015. These two assessments were available as a hard copy and made available at the bi-weekly employee meeting. Participants returned the assessments to a designated pick up folder in the management office to ensure privacy and to avoid any potential tampering with the completed assessments. The surveys took approximately ten to fifteen minutes to complete. The participants' identities and results remained confidential for the duration of the study through the use of a coding system.

Risk awareness was designed to be tested before and after the toolbox talks, and hypothesized the toolbox talks would increase awareness of the hazards in the workplace. If awareness of unsafe conditions and acts could be increased, potential decisions made by the staff could be changed due to an increase in knowledge and awareness. Research on situation awareness and risk perception was referred to and used in the creation of the risk awareness assessments to ensure the surveys were focused in their design of risk knowledge and perception item measurement.

CHAPTER 4: RESULTS

Multiple analyses were conducted on the pre-risk awareness assessments and the safety audit results. The results from the pre-risk awareness assessments will be presented first. Demographics, descriptive statistics, and odds ratios were conducted on the assessments. Safety audit results are presented second with normality test results, descriptive statistics, and independent sample t-test results. Finally, I-MR control charts and reports for capability analysis are presented for the safety audit data.

4.1 Risk Awareness Assessments Results

The Risk Awareness Assessment focused questions on trying to understand the participants' level of understanding in relation to the risk their work environment presents, and how they may respond or if they recognize the risks and hazards in their environment. Analysis methods attempted to understand the risk perception at each dining hall studied, and also compare the risk level perceived by employees to the actual risk level based on past and present events as noted by the employees in the risk awareness assessment. For this portion of the study and analysis, recall:

H_1 = Personal risk awareness in employees will increase after toolbox talks are conducted.

Employees received two toolbox talk sessions for the duration of the study. The first toolbox talk topic was on "Lifting Safely", and the second toolbox talk on "Unsafe Conditions & Unsafe Acts". Unfortunately, due to a low response rate for the post-risk awareness assessments there was not enough data to allow for a comparison for the before and after risk awareness assessments for dining hall A, and still limited responses (only 7 paired samples) for dining hall B. However, data collected from the pre-risk awareness assessments was still useful in determining areas and risks that resonated on a personal level with staff and could then be connected to concerns relating to process items from the safety audits.

4.1.1 Pre-Risk Awareness Assessment Demographics

Completion of the risk awareness assessment was completely voluntary. Participants in the pre-risk awareness assessment for both dining halls were full-time staff members and consisted of cooks, custodians, and store clerks, with the exception of three part-time employees. There were 29 participants for the pre-risk awareness assessment between both Dining Hall A and Dining Hall B. Ten assessments were collected from Dining Hall A ($N = 21$) resulting in a response rate of 47%, and 19 assessments were collected from Dining Hall B ($N = 28$) resulting in a response rate of 67%. A total response rate of 59% was achieved between both dining halls.

Age ranges were used to further protect the participants' personal information and follow the coding also used by the Bureau of Labor Statistics. The majority of participants fell into the 25 to 34 years, and the 35 to 44 years, and the 45 to 54 years ranges. See Table 1 – Risk Awareness Assessment Demographic – Participants Age Ranges for specific details.

Table 1 – Risk Awareness Assessment Demographic – Participants Age Ranges

Age Range	Dining Hall A	Dining Hall B	Total	Percent
20-24	0	1	1	3.45%
25-34	0	6	6	20.69%
35-44	0	6	6	20.69%
45-54	4	5	9	31.03%
55-64	6	1	7	24.14%
Total	10	19	29	100%

The mean for years of employment at the dining halls was 7.68 (with a standard deviation of 7.81). See Table 2 – Risk Awareness Assessment Demographics - Years of Employment at Dining Halls for specific details between

dining halls. Employment status of the assessment participants included 90% full-time employees and 10% part-time employees.

Table 2 - Risk Awareness Assessment Demographics – Years of Employment at Dining Hall A and B

Years of Employment	Dining Hall A	Dining Hall B	Cumulative Total	Percent
0 - 1.99	1	5	6	20.69%
2 - 5.99	1	9	10	34.48%
6 - 9.99	2	1	3	10.34%
10 - 13.99	0	1	1	3.45%
14 - 17.99	1	3	4	13.79%
18 - 21.99	3	0	3	10%
22 - 25.99	0	0	0	0%
26 - 30	1	0	1	3.45%
Total	9	19	28	96.55%

* Missing n = 1

4.1.2 Pre-Risk Awareness Assessment Descriptive Statistics

The risk awareness assessments asked many questions pertaining to risk and the employees' recognition, interaction, and prevention of these risks that the eating and drinking industry present. The descriptive statistics are for both Dining Hall A and Dining Hall B responses combined. See Appendix F for a detailed table of all descriptive statistics for both dining halls combined and for descriptive statistics for each dining hall separately. The risk awareness assessment asked employees how well they liked their job using a 5 point Likert scale (1=I strongly dislike my job, 5= I always love my job). The mean for how well employees like their job was 4.20 (with a standard deviation of 0.4123). 79.3% of respondents said they like their job most of the time, a 4 rating on the Likert scale, while 20.6% of respondents said they always love their job, a 5 rating on the Likert scale.

The assessment also inquired as to if the employee had experienced an incident or near miss at work. 17 participants (58.6%) answered they had experienced an incident or near miss at work, and 12 (41.3%) participants responded they had not experienced an incident or near miss at work. Of those participants that indicated they had experienced an incident or near miss, 13 participants (81.2%) said the experience directly changed how they thought about safety in the workplace while 3 (18.7%) said it did not.

Additionally, 68.9% of respondents said they have witnessed an incident or near miss at their workstation, and 89.6% of respondents have physically stopped a co-worker from performing a task if they were seen not following a safety procedure. The assessment results also indicated that 96% of employees have recognized a situation at work they considered to be potentially hazardous (i.e. broken or missing PPE, broken equipment, wet floor, spills). Lastly, employees were asked to rate their job based on the health and safety risks they felt their work exposed them to using a 5 point Likert scale (1=my job is not dangerous at all, 5=my job is very dangerous that presents high or threatening risks). Most participants responded in the following two ways: 22.2% of respondents indicated they felt their job was only slightly dangerous with minimal risks, and 55.5% of respondents indicated they felt their job was only somewhat dangerous with moderate risks. See Table 3 – Risk Awareness Assessment Descriptive Results – Participant Rating of Job Danger

Table 3 - Risk Awareness Assessment Descriptive Results – Participant Rating of Job Danger

Job Danger	Dining Hall A	Dining Hall B	Cumulative Total	Percent
1	0	2	2	7.41%
2	3	3	6	22.22%
3	5	10	15	55.56%
4	1	2	3	10.34%
5	1	0	1	3.45%
Total	10	17	27	93%

Participants were also asked to name five hazards in their work environment and 4 common types of injuries for their work environment. Only 41% of respondents listed at least 5 hazards for their work environment, leaving 58% of respondents unable to list at least 5 hazards for their work environment. The responses for identified work environment hazards were categorized by themes: injuries, equipment/materials, design of work environment, task-related, worker induced/management, food safety. Of the total 105 hazards listed by all participants, 26 (24.7%) of them were injuries, 23 (21.9%) were equipment/materials, 6 (5.7%) were design of the work environment, 29 (27.6%) were task-related hazards, 15 (14.2%) were human/management related, and 5 (4.7%) were food safety hazards. See Appendix G for a complete graph of all the listed hazards and hazard themes.

The next question asking to list 4 common types of injuries had the same response rate as the identifying hazards question – 41% being able to list 4 common types of injury, and 58% unable to list at least 4 injury types. Of the 83 total responses, 24 (28.9%) were burns, 21 (25.3%) were cuts, 21 (25.3%) were slips/falls, 2 (2.4%) were strains/sprains, 6 (7.2%) listed back pain specifically, 2 (2.4%) were hand/wrist pain, 2 (2.4%) listed heat exhaustion, and 5 (6%) listed items that were not types of injuries (i.e. broken dishes, hot pans). See Appendix H for a complete graph of all the listed injuries.

4.1.3 Pre-Risk Awareness Assessment Odds Ratios

Odds Ratios (OR) calculate the odds that a certain exposure is associated with a certain outcome. The ratio is calculated based on the outcome to a given exposure against the outcome in the absence of the given exposure. Risk factors and exposures can be identified based on the odds of a given outcome from the studied exposures. Possible odds ratio outcomes can be equal to 1, meaning no association is present between the exposure and outcome, less than 1 or greater than one. An OR less than one indicates the odds of the outcome are less than likely, and an OR greater than one indicates a high likelihood of the outcome based on the exposure.

Outcome and exposure is organized into a two-by-two frequency table.

Exposure		Outcome	
		+	**-**
	+	A	B
	-	C	D

The formula for OR is as follows:

$$\text{Odds Ratios} = \frac{(a \times d)}{(b \times c)}$$

Odds Ratios were calculated on the assessment results to compare the odds of an event between the two dining halls studied. The analysis revealed that employees at Dining Hall A are 2.1 times more likely to have an incident than employees at Dining Hall B. Additionally, employees at Dining Hall A are 2.33 times more likely to witness an incident or near miss than employees at Dining Hall B. For employees that experienced an incident at work, they are 1.33 times as likely to be unsure of the necessity of safety training as compared to those who did not have an incident. See Appendix I for tables of odds ratios performed on the Pre-Risk Awareness Assessment results.

4.2 Safety Audits Results

A total of 30 audits were conducted between Dining Hall A and Dining Hall B. The 30 audits were divided between 5 meal periods, breakfast, lunch and dinner for one dining hall, and lunch and dinner for the second dining hall. Thus, 6 audits per meal period were conducted for the length of the study. Multiple scores were calculated for each audit: an overall audit score, a score for each sub area within the dining hall(s), and indicator item scores for items being monitored within each sub area (i.e. PPE accessibility, organization).

Recall the proposed hypothesis for the safety audits and toolbox talks:

H_2 = Performance of safety processes (safety audit scores) will increase after the introduction of toolbox talks and continued use of safety audits.

In addition, objectives for the study included supporting the development of safety audits in a customized manner so that leading indicators could be applied at the process level to monitor safety processes in a work environment.

4.2.1 Normality of Safety Audit Scores

The overall audit scores for both dining halls were tested for a normal distribution in Minitab 17. The overall audit scores for both dining halls were confirmed to be normally distributed by the Anderson Darling method (p-value = 0.388). See Figure 1 for the Normality test results.
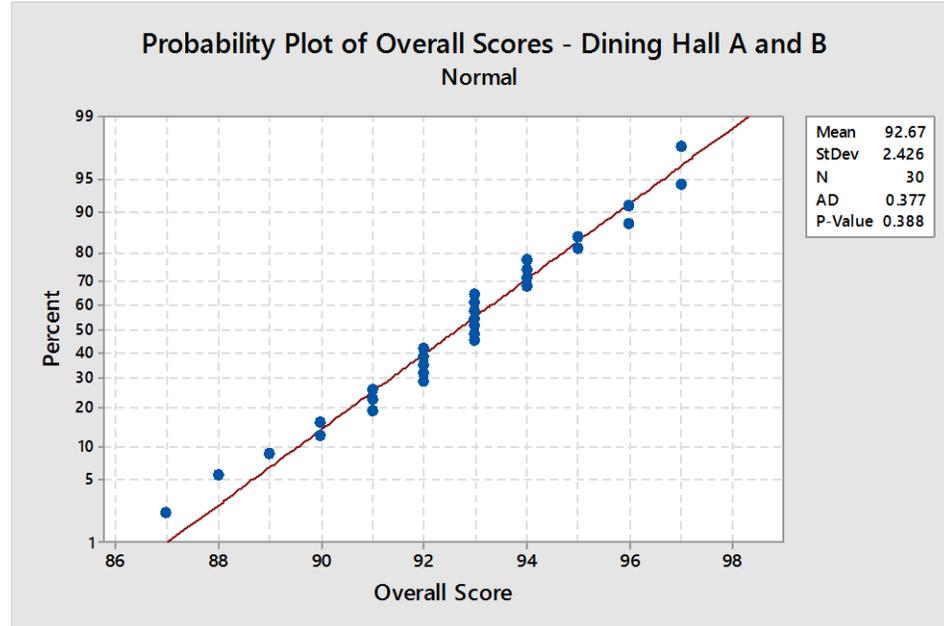
Figure 1 – Test for Normality Results – Overall Audit Scores for Dining Hall A and B

4.2.2 Safety Audit Descriptive Statistics

Descriptive Statistics were conducted for all safety audits and separately for each dining hall. Major areas of focus for the audits and dining halls include multiple storage areas, kitchen, concept serving area, dishwashing area, and the walk-in freezer. See Table 4 – Safety Audit – Descriptive Statistics for Both Dining Halls for the mean scores for the main areas of focus within the dining halls. Descriptive Statistics for each of the dining halls for the major areas of focus can be seen in Appendix J.

Table 4 – Descriptive Statistics for Safety Audit Scores for Dining Hall A and B

Audit Area	Mean	Std. Dev	Minimum	Median	Maximum
Overall Score	92.67	2.43	87	93	97
Food Storage	85.20	7.26	70	84	100
Storage	78.00	22.85	0	79	99
Kitchen	96.87	1.98	93	97.5	100
Concept Area	94.63	2.95	88	95	99
Dishwashing	90.10	9.44	65	92	100
Freezer	84.97	9.31	66	86	100

Throughout the data collection process, some audit areas demonstrated a constant low scoring pattern, or exhibited an increase in scores then a gradual decrease over time. The storage area for Dining Hall A experienced a consistent low score throughout the auditing process, while the kitchen had a very rigged high-low-high pattern. The concept serving area and food storage area had unpredictability relative to their scores audit to audit.

Overall, both Dining Halls had relatively consistent scores during the auditing time period, though they were each consistent at their own scoring level. Dining Hall A had somewhat lower scores than Dining Hall B for the duration of the audits. Certain areas in both dining halls had consistent scores, such as the walk-in coolers, whose product level, temperature level, and cleanliness must be maintained as a food safety precaution.
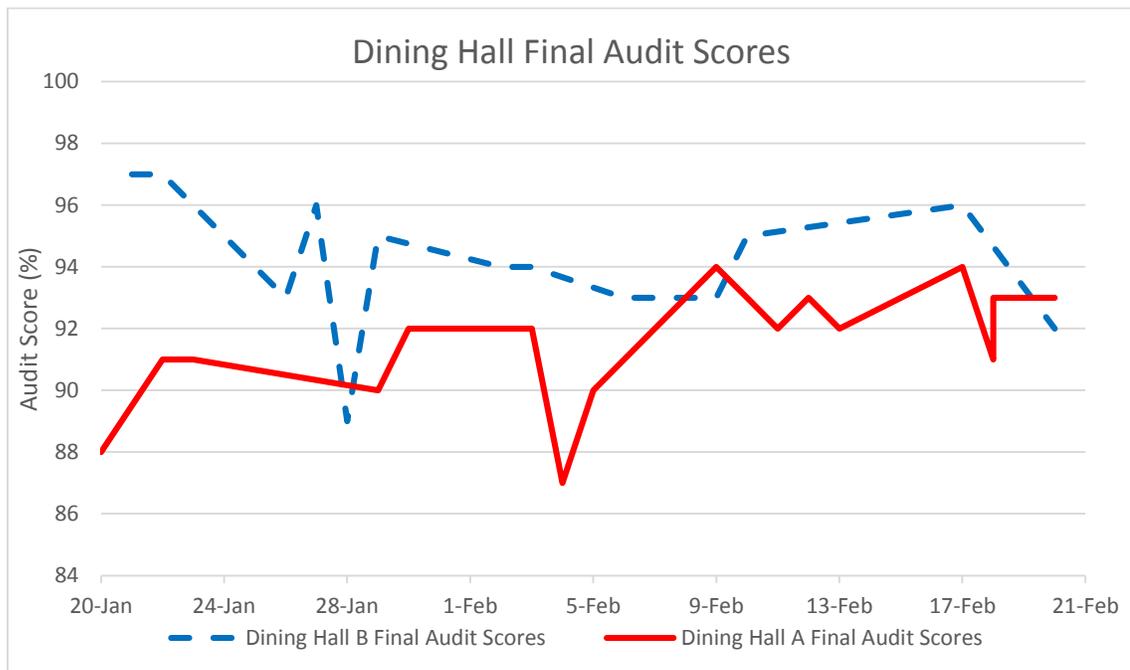
Figure 2 – Dining Hall Overall Scores for Dining Hall A and B

4.2.3 Independent Samples T-test for Safety Audit Scores

An independent samples t-test was conducted on the safety audit scores for Dining Hall A and Dining Hall B for the sub-areas monitored on the audits. The t-test found statistically significant ($p=0.05$) differences between the dining halls for the following areas: overall scores, storage, walk-in freezer, and the dishwashing area. See Table 5 – Statistically Significant Independent Samples T-test for Safety Audit Sub-Area Scores for scores only found to be statistically significant.

Table 5 – Statistically Significant Independent Samples T-test for Dining Hall Sub-Areas

Independent Samples T-test: Dining Hall A and B							
Audit Area	Dining Hall	N	Mean	Std. Dev	T-value	P-value	DF
Overall Score	A	12	94.58	1.68	4.76	0.000	26
	B	18	91.39	1.97			
Storage	A	12	97.5	1.31	6.54	0	17
	B	18	65	21			
Freezer	A	12	90.67	7.15	3.26	0.003	26
	B	18	81.17	8.74			
Dishwashing Area	A	12	85	13	-2.22	0.047	12
	B	18	93.5	3.57			

4.2.4 Safety Audits and Toolbox Talks

The toolbox talk topics were chosen based on poor performing sub-scores and indicator scores from audits leading up to the scheduled toolbox talks. The first toolbox talk topic was on lifting safely. This topic was chosen because ergonomics relating to shelf storage were the consistently low scoring indicator on the audits, especially in the freezer and walk-in fridge areas. In addition, strains and sprains, especially those from an unknown source, were a major portion of injuries that occurred in the 2014 year.

The second toolbox talk was on a broader subject of unsafe conditions and unsafe acts. Incidents are often categorized as either originating from an unsafe act or an unsafe condition. Knowing how unsafe acts and unsafe conditions can be controlled, recognized, and acted upon is a basic skill set that even non-safety professionals should be able to master. For the second toolbox talk there was no one sub-area or indicator score(s) that presented itself as a priority; therefore, a general hazard identification toolbox talk was used for the second talk. The topic of unsafe conditions and unsafe acts also aligned better with the goal to test risk awareness in the staff.

Part of H_1 proposed to test the audit scores and process performance after toolbox talks had been delivered to the staff to see if a change in process

performance was also experienced. Miscommunication and scheduling difficulties with management prevented the toolbox talks from being conducted at their originally planned scheduled intervals. As a result, there was a larger than anticipated measurement period between toolbox talk 1 and 2 which resulted in not enough data being collected after toolbox talk 2 to determine if an increase in the performance, as well as a decrease in process variation, had occurred after the introduction of the toolbox talk training.

However, even with limited data points after toolbox talk 2, dining hall A did see an increase in some of the sub-areas' performance that related to the toolbox talk topics. For example, the kitchen score and overall audit score saw a mean increase after the toolbox talk on recognizing unsafe conditions and unsafe acts was conducted as shown by an I-MR chart. See Figure 3 – Before/After TBT#2 Dining Hall A: Overall Audit Scores and Figure 4 – Before/After TBT#2 Dining Hall A: Kitchen Scores. An assumption could be made that if data collection were to continue for a longer amount of time, and possibly after the implementation of multiple toolbox talks continuously focused on poor performing areas, an increase in performance and decrease in variation for those assessed areas could very well be achieved.
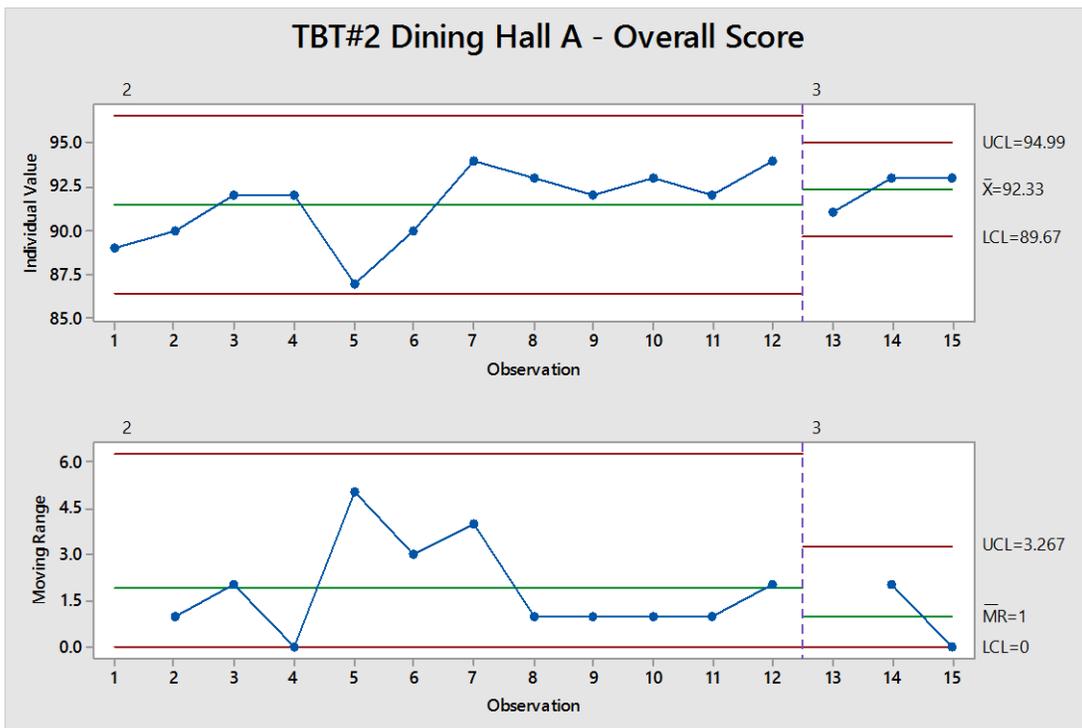
Figure 3 – Before/After TBT#2 Dining Hall A: Overall Audit Scores
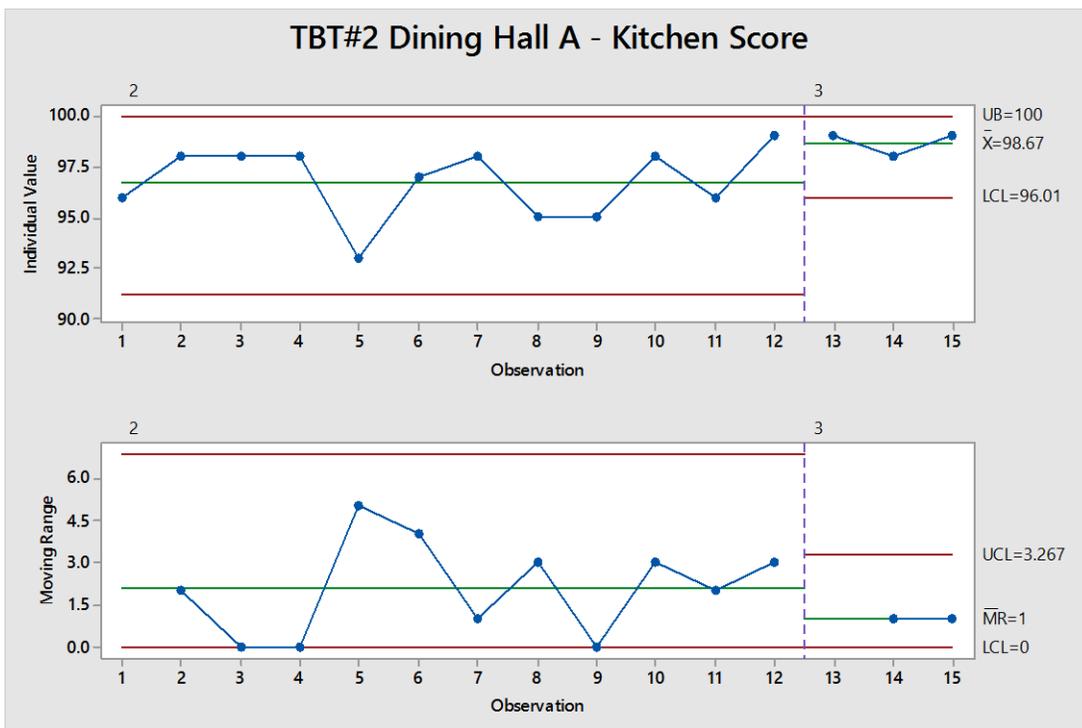
Figure 4 – Before/After TBT#2 Dining Hall A: Kitchen Scores

4.2.5 Safety Audit Results by Area

       The approach used to analyze safety audit results consists of a three step check process. First, data for the audit, sub-area, or indicator is checked for normality. Next the data is plotted on an I-MR control chart. An upper bound of 100 was forced on the control charts, but is only displayed when the UCL is over 100. An upper bound of 100 is used because audit scores are on a 0 to 100 percent scale, thus audit scores cannot be over 100. The control charts are examined for out of control points, if the process is stable a capability analysis is performed with a lower specification limit (LSL) of 80. Additional values used from the capability analysis are Cpk and Ppk. These values demonstrate the process' future and current capability to perform at the specified LSL based on its current performance and variability.

       The safety audit data was plotted on I-MR control charts to test for process stability, performance, and variation. By using control charts, the process stability allows for special causes to be identified and may indicate the safety process is not being followed as it should. Special causes in indicator items, which are directly related to past incidents and incident reports, can ultimately be treated as root cause processes for past incidents. As they continue to produce special cause variation, the processes continue to pose and signal the potential risk for injury as the processes are not performing as they should. Out of control points traditionally signal special causes in the process that need investigated. However, this concept cannot accurately apply to safety performance data because higher scores and performance is sought out, so out of control points over the UCL are not considered as troublesome as out of control points below the LCL. In safety and health, a higher performance is suggestive of a safer environment with risks controlled to an adequate or excellent level. Point above the upper control limit, those of higher than normal performance should not be regarded as attention critical. See Table 6 – Safety Audit Data Dashboard (Control Chart, Capability) for summary results of the analyses performed on the audit results.

Table 6 - Safety Audit Data Dashboard

Dining Hall	Area	In Control		Capable	
		Yes	No	Yes	No
A	Overall Storage		X		
A	Storage Ergonomics		X		
A	Storage Organization		X		
B	Overall Storage	X		X	
B	Storage Organization		X		
A	Overall Freezer	X		X	
A	Freezer Floor Cleanliness	X			X
A	Freezer Ergonomics	X			X
B	Overall Freezer		X		
B	Freezer Ice Build up		X		
B	Freezer Floor Cleanliness		X		
A	Overall Kitchen	X		X	
A	Kitchen PPE Usage		X		
A	Kitchen PPE Accessibility		X		
B	Overall Kitchen	X		X	
B	Kitchen Counter Cleanliness		X		
B	Kitchen Floor Cleanliness	X			X
B	Kitchen Organization		X		
A	Overall Dishwasher Area		X		
A	Dishwasher Floor Cleanliness	X			X
A	Dishwasher PPE Accessibility		X		
B	Overall Dishwasher Area	X			X
B	Dishwasher Floor Cleanliness	X			X
B	Dishwasher Path of Egress	X			X
A	Overall Concept Area	X		X	
A	Concept Floor Cleanliness	X			X
A	Concept PPE Accessibility		X		
B	Overall Concept Area	X		X	
B	Concept Floor Cleanliness	X			X
B	Concept Counter Cleanliness	X			X
B	Concept PPE Usage	X			X

4.2.5.1 Consistent Audit Scoring Areas

During the duration and analysis of audit data, there were several sub-areas that scored consistently throughout the data collection period. The general storage room and dairy cooler scored consistently high for dining hall B the duration of auditing. The storage room held a mean score of 97.25 (UB=100, LCL=94); the dairy cooler held a mean score of 100. All other sub-areas measured had a greater variation or out of control points and processes.

4.2.5.2 Storage Areas

Both dining halls use their storage rooms for different types of items, which may be attributed to their location in the dining hall. The storage room for dining hall A contained surplus items (i.e. employee shirts, hats, holiday decorations) and cleaning equipment (i.e. vacuums, carpet extractors, leaf blowers). The storage closet is not in a commonly accessed area of the dining hall, so most items in this storage area are not commonly used items. Analysis and control charts for this storage area show an out of control process with out of control points at both above and below the control limits. See Figure 5 – Dining Hall A: Overall Storage Scores.
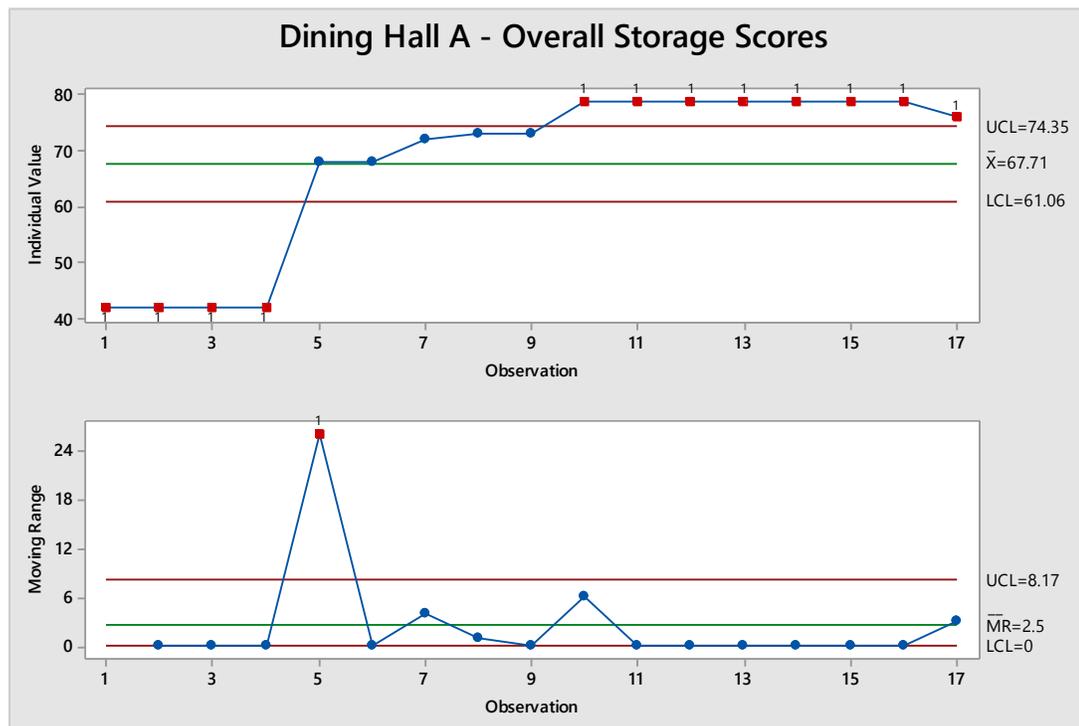
Figure 5 – Dining Hall A: Overall Storage Scores

The storage area showed extremely low scores upon the start of auditing, with organization, and ergonomics in relation to shelf storage, presented as the main issues. See Figure 6 – Dining Hall A: Storage Area Ergonomics and Organization. More information on the trend of performance for the Dining Hall A storage area will be presented in the discussion chapter.
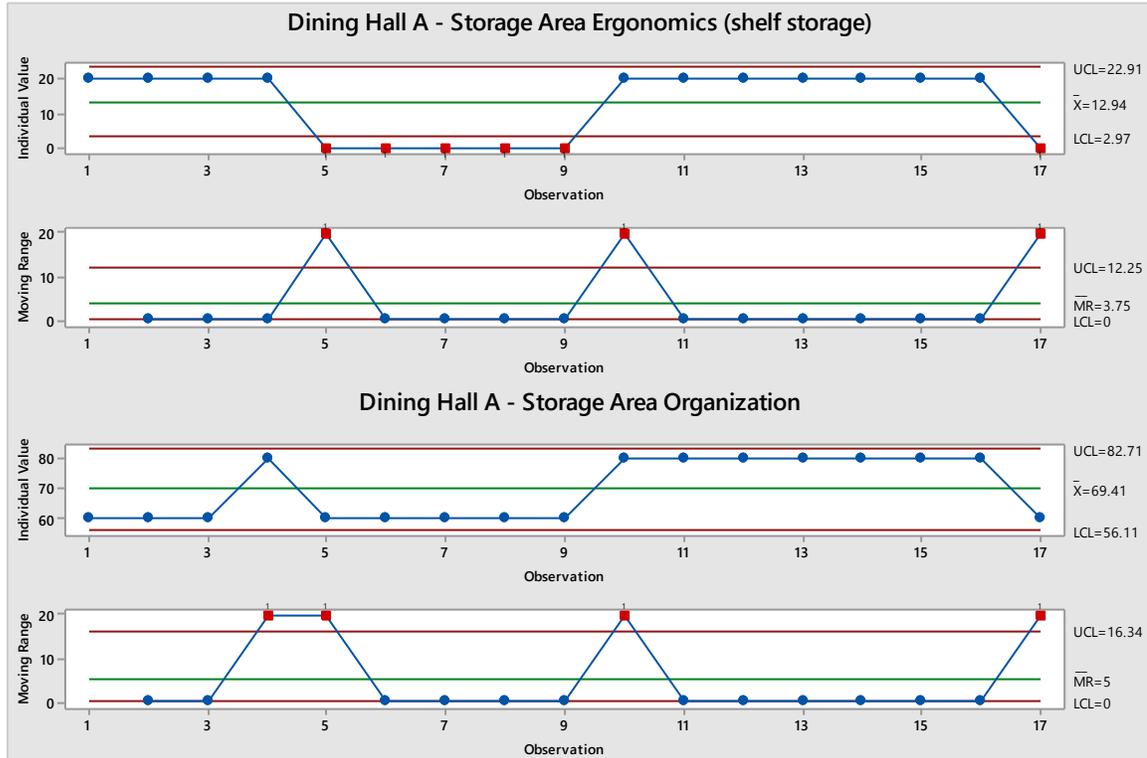
Figure 6 – Dining Hall A: Storage Area Ergonomics and Organization

Dining hall B used their storage to store surplus cleaning chemicals, PPE, and cleaning equipment. Their storage room was in an area that is commonly and frequently accessed by maintenance and custodians and thus had higher and more consistent overall scores, as demonstrated by an I-MR control chart. See Figure 7 – Dining Hall B: Overall Storage Scores. Additionally, the control chart for storage organization specifically shows an out of control process with special causes. These special causes can be explained as remodeling and reorganization in the storage room was taking place during these audits. It's also important to note that the out of control points that have values of 100 hold a lesser degree of concern than those below the LCL. See Figure 8 – Dining Hall B: Storage Room Organization for the I-MR chart for Organization.
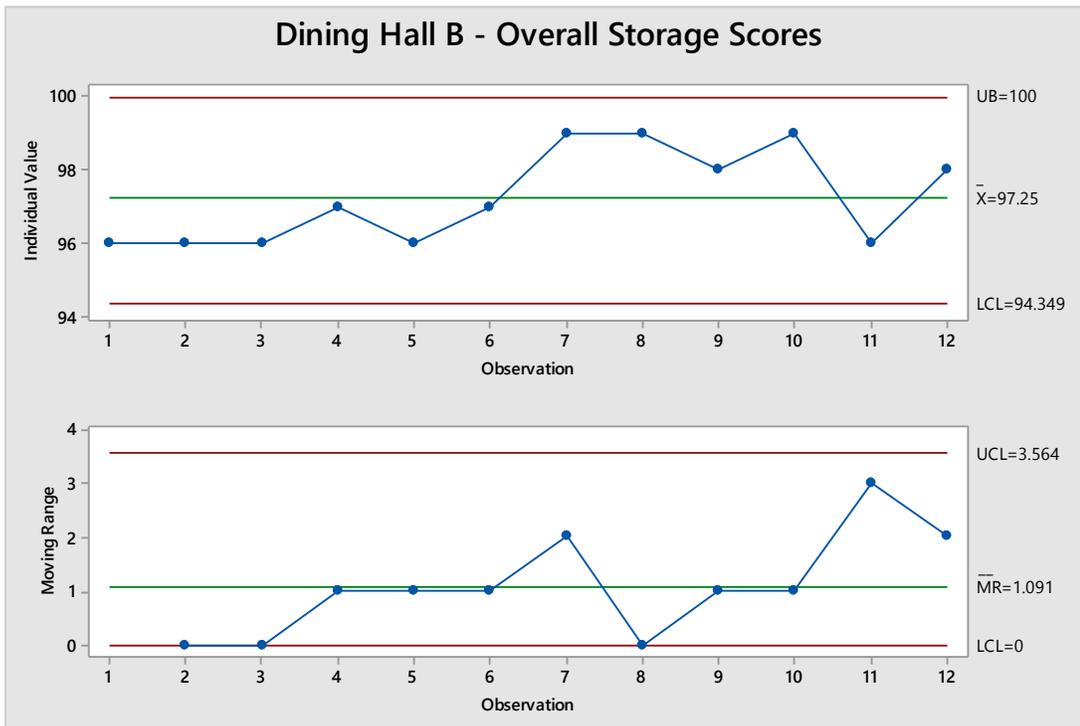
Figure 7 – Dining Hall B: Overall Storage Scores
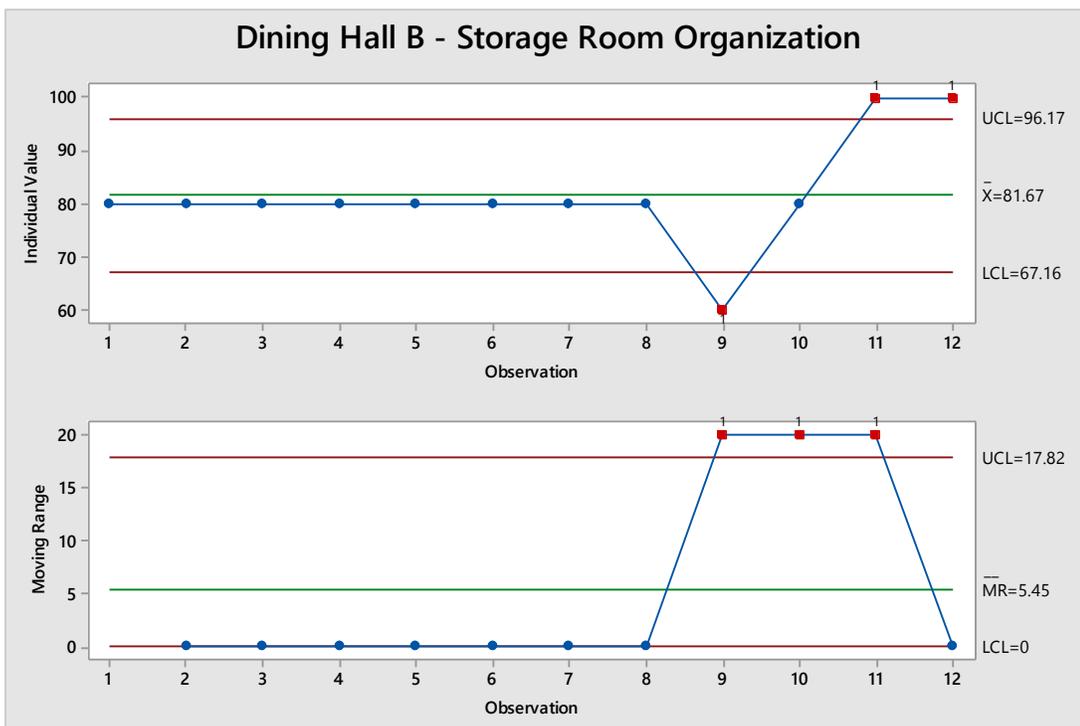
Figure 8 – Dining Hall B: Storage Room Organization

Dining hall B's storage area demonstrated an overall stable process for performance. A process capability analysis report was conducted. See Figure 9 – Process Capability Report Dining Hall B: Storage Area for the report results. A lower specification limit of 80 is chosen for the capability analysis because it is a general passing grade score. The results from the capability report show that the storage area performance is currently (Ppk = 4.46) and potentially (Cpk = 4.36) capable of meeting this specification limit. Industry standards require a Cpk or Ppk of 1.33 or greater for process capability.
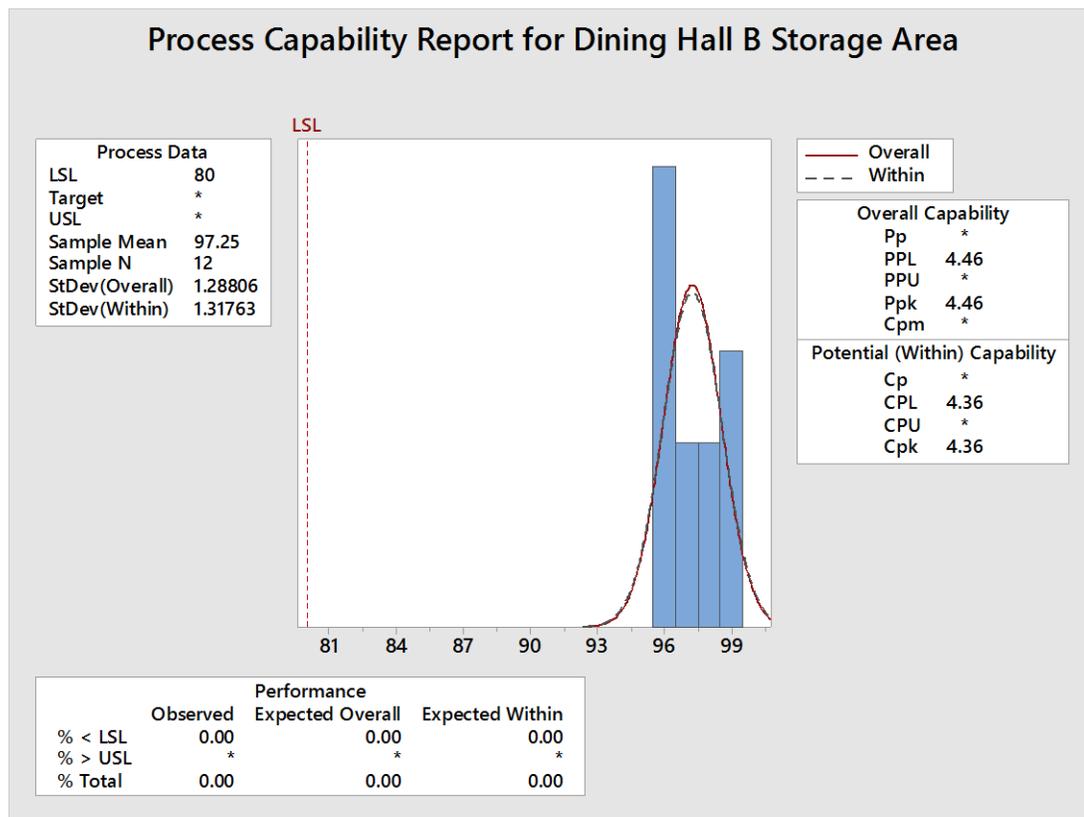
Figure 9 – Process Capability Report Dining Hall B: Storage Area

4.2.5.3 Walk-In Freezer

Dining hall A's walk in freezer held an average mean of 80.83, with one outlier at farther than three standard deviations from the mean. However, the

outlier, plotted at 100, is above the UCL (96.63). As previously stated, out of control points that exceed the normal range would not be as seriously concerning as points below the LCL. See Figure 10 – Dining Hall A: Overall Freezer Scores for Freezer area performance.
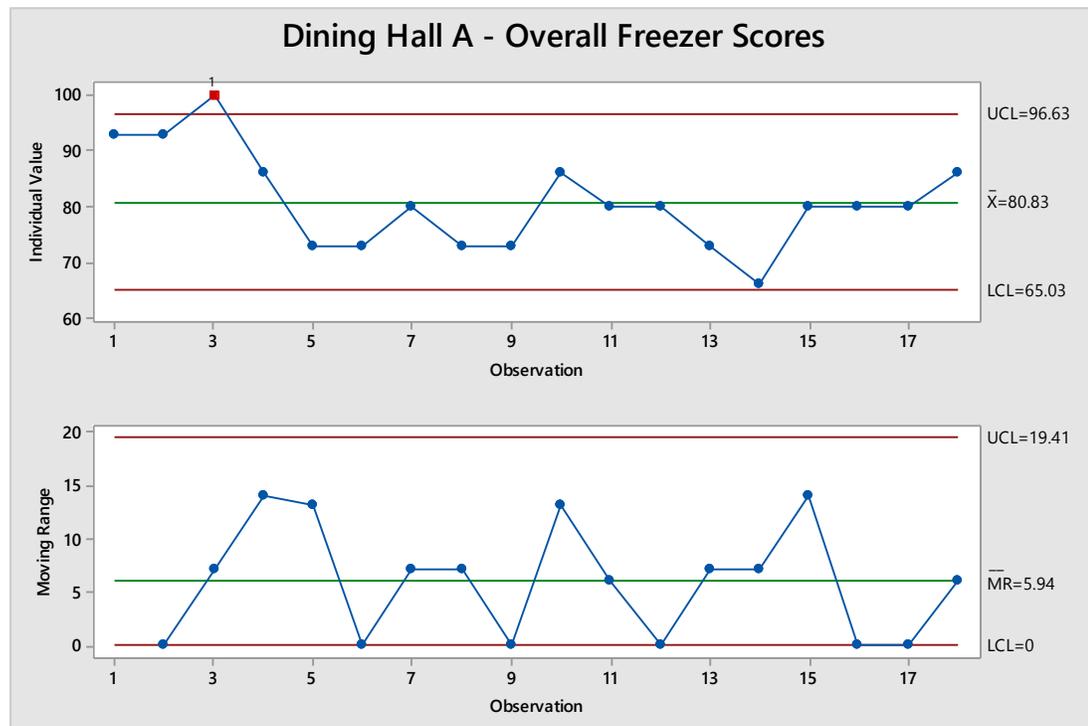
Figure 10 – Dining Hall A: Overall Freezer Scores

Indicator items such as ice build-up in the freezer, ergonomics relative to shelf storage, and floor cleanliness were also measured for the walk-in freezer. Ice build-up scored 100 consistently throughout the freezer, meaning there was no ice-build up in the freezer for the duration of auditing. The ergonomic and floor cleanliness indicators demonstrated some variation, but still resulted in stable processes. See Figure 11 – Dining Hall A: Freezer Area Ergonomics and Floor Cleanliness.
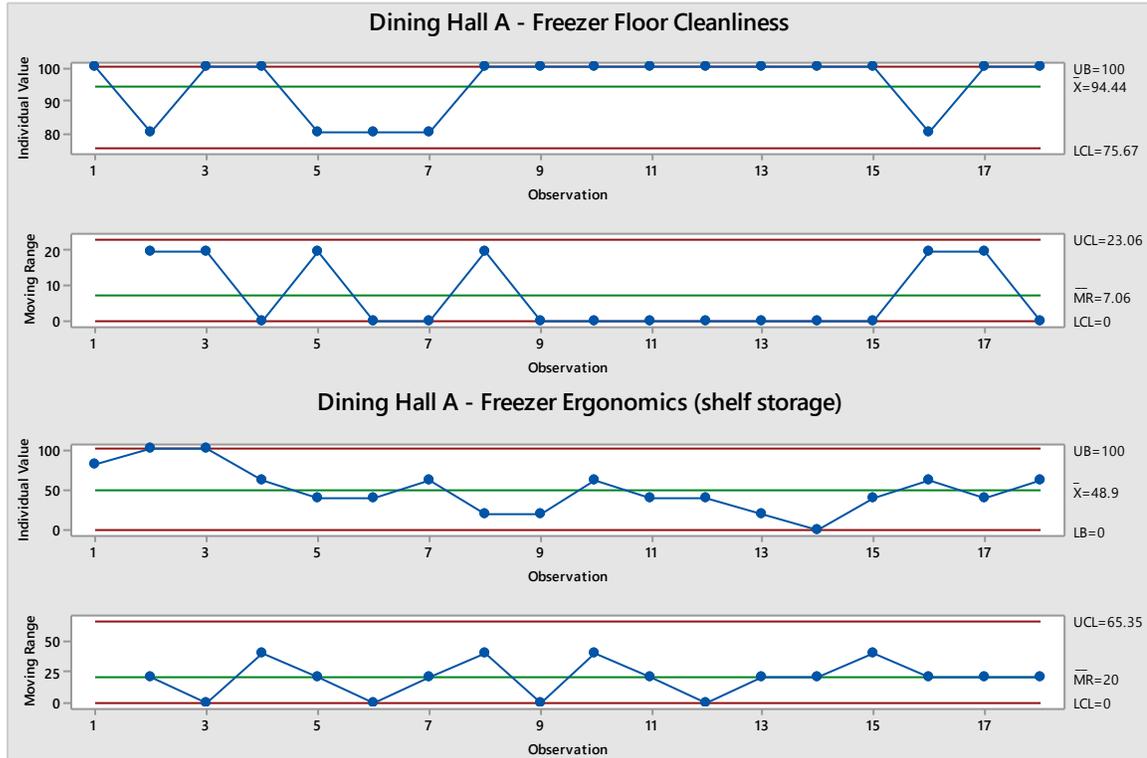
Figure 11 – Dining Hall A: Freezer Area Ergonomics and Floor Cleanliness

Floor cleanliness for the storage area carried a mean of 94.4 (UB=100, LCL=75.67). The mean for the ergonomics indicator for shelf storage was much lower at 48.9. An upper bound of 100 and a lower bound of 0 was used on the ergonomics control chart because scores are in units of percent.

A capability analysis was conducted on the shelf storage and floor cleanliness for the freezer area. Capability was not assessed for the overall scores because the process was out of control. The shelf storage capability analysis results yielded a Cpk value of -0.38 and a Ppk value of -0.39. See Figure 12 – Process Capability Report Dining Hall A: Freezer Ergonomics. Based on the capability report and following a standard of 1.33 for a Cpk and Ppk value, the process is incapable of meeting current and future performance at an 80% scoring threshold.
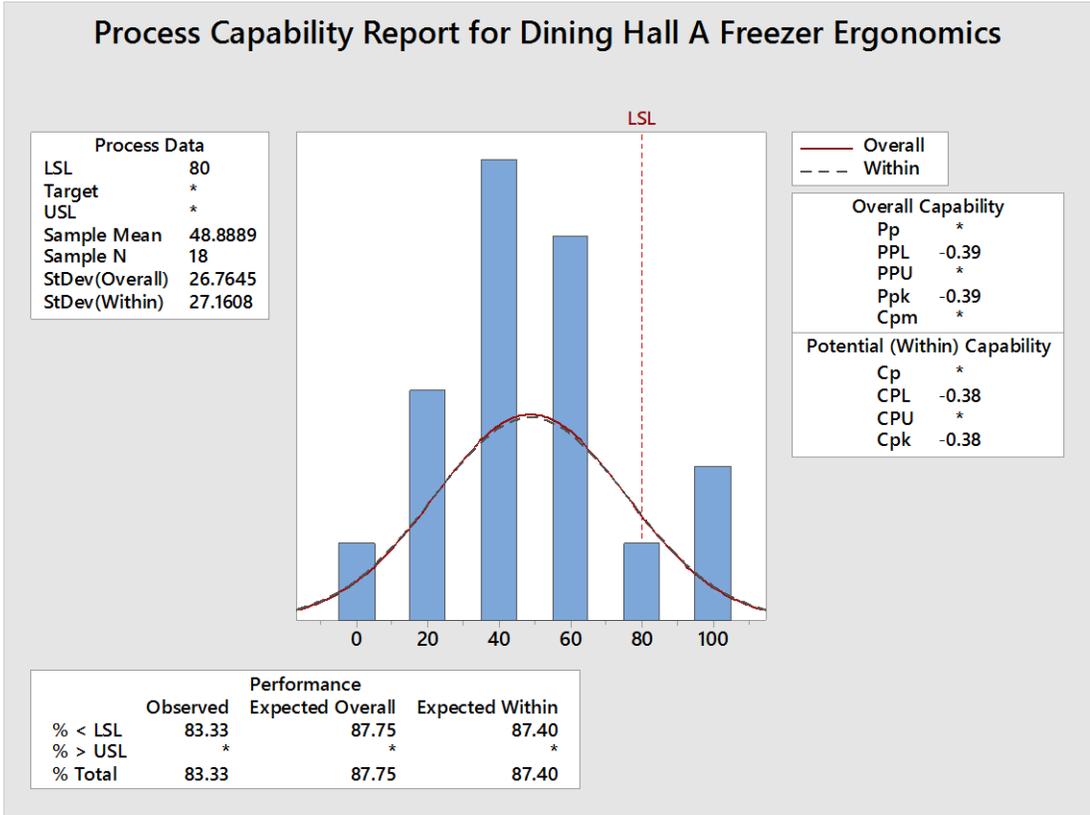
Figure 12 – Process Capability Report Dining Hall A: Freezer Ergonomics

A capability analysis was also conducted on floor cleanliness for the freezer. Results yielded the following values: Cpk = 0.51, Ppk = 0.52. This process is also incapable of performing at the LSL of 80%. See Figure 13 – Process Capability Report Dining Hall A: Freezer Floor Cleanliness.
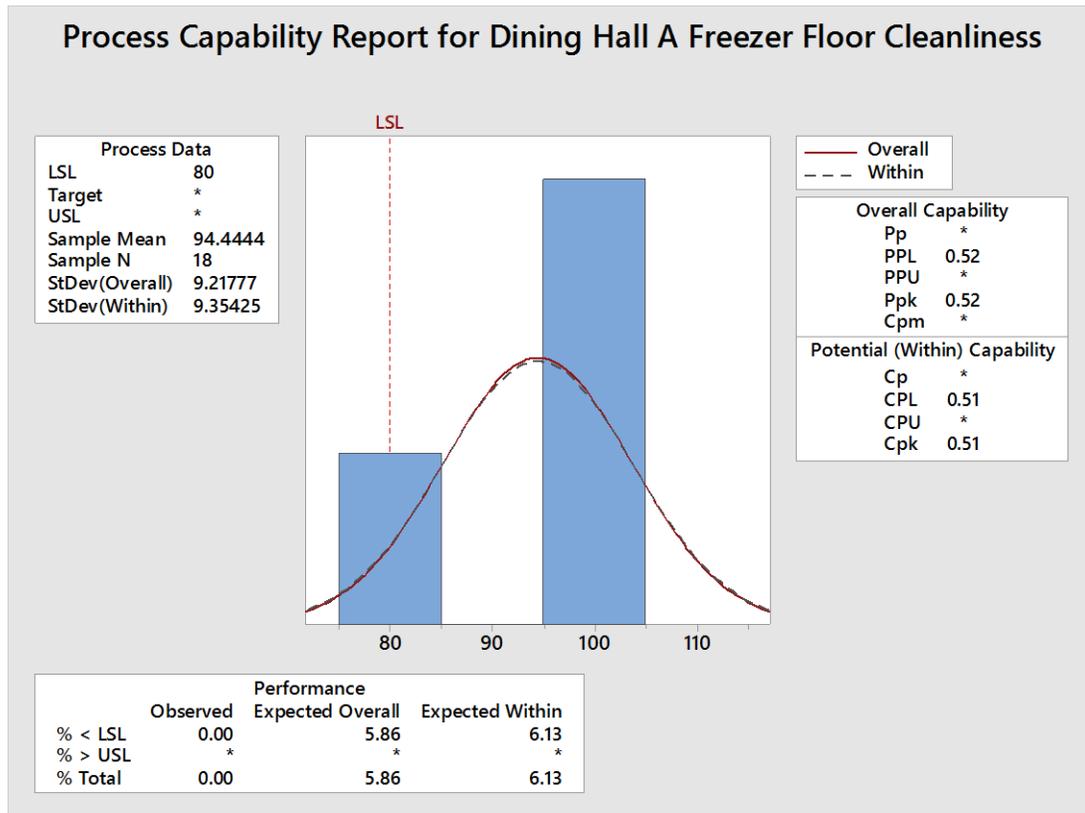
Figure 13 – Process Capability Report Dining Hall A: Freezer Floor Cleanliness

Dining hall B's walk-in freezer scores yielded a mean of 90.67 (UCL=96.95, LCL=84.38). The I-MR control chart displays four out of control points for the freezer area. See Figure 14 – Dining Hall B: Overall Freezer Scores.

The indicator score for shelf storage and relative ergonomics scored a consistent 100 throughout the auditing process. The performance of the ice-build up indicator and floor cleanliness for the freezer however, resulted in an unstable process. An upper bound was set at 100 for the UCL on floor cleanliness. Figure 15 – Dining Hall B: Freezer Area Ice-build up and Floor Cleanliness. A capability analysis was not conducted for any indicators for the freezer area in dining hall B because the processes were not stable.
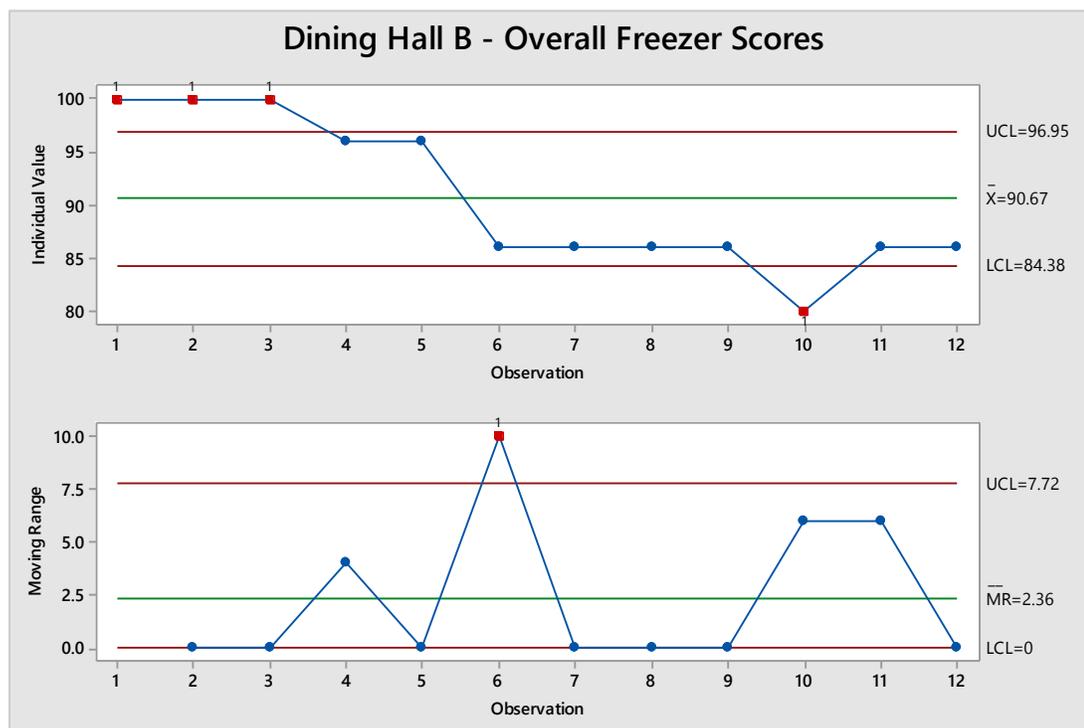
Figure 14 – Dining Hall B: Overall Freezer Scores
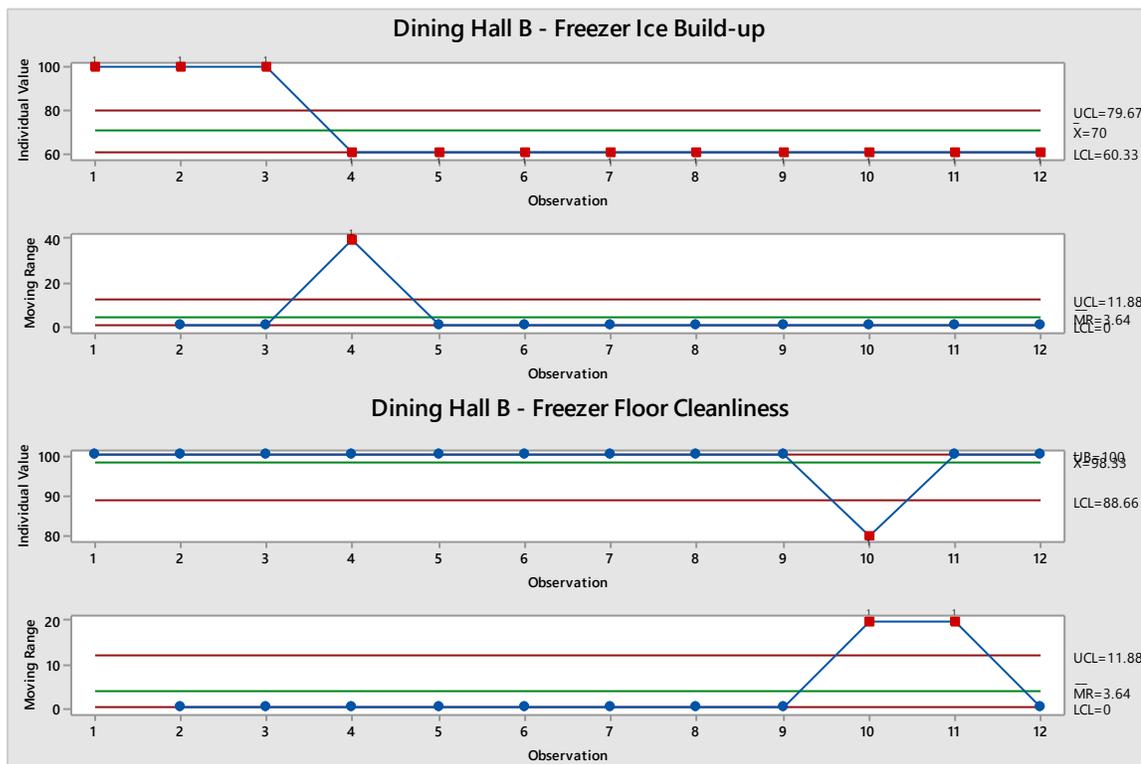
Figure 15 – Dining Hall B: Freezer Area Ice Build-up and Floor Cleanliness

4.2.5.4 Kitchen

The kitchen area for dining hall A yielded a mean score of 95.39 (UB=100, LCL=85.06). The performance of the kitchen area overall was demonstrated to be stable and in control. See Figure 16 – Dining Hall A: Overall Kitchen Scores. Floor cleanliness and counter cleanliness control charts both had out of control points farther than three standard deviations from the mean. The mean for floor cleanliness was 97.22 (UB=100, LCL=87.84), and the mean for counter cleanliness was 98.89 (UB=100, LCL=95.76. See Appendix K for the control charts for kitchen counter and floor cleanliness for dining hall A. PPE usage and accessibility were also monitored for the kitchen area. See Figure 17 – Dining Hall A: PPE Usage and Accessibility for the control charts. There is one data point missing for the PPE usage control chart because auditing took place during a downtime when employees were not working or required to wear PPE. PPE

usage held a high mean of 97.65 and a LCL of 87.01. PPE accessibility demonstrated a mean of 80.28, a LCL of 72.46, and an UCL of 88.10. A capability analysis was not performed because the processes and indicators were demonstrated to be out of control and unstable.
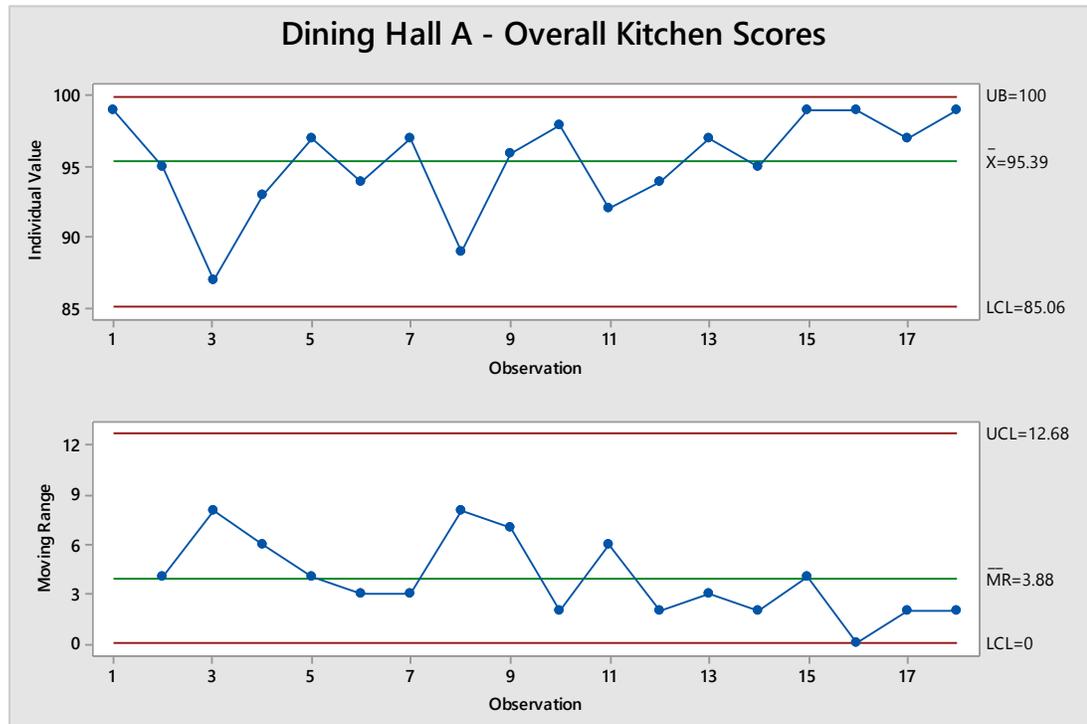
Figure 16 – Dining Hall A: Overall Kitchen Scores
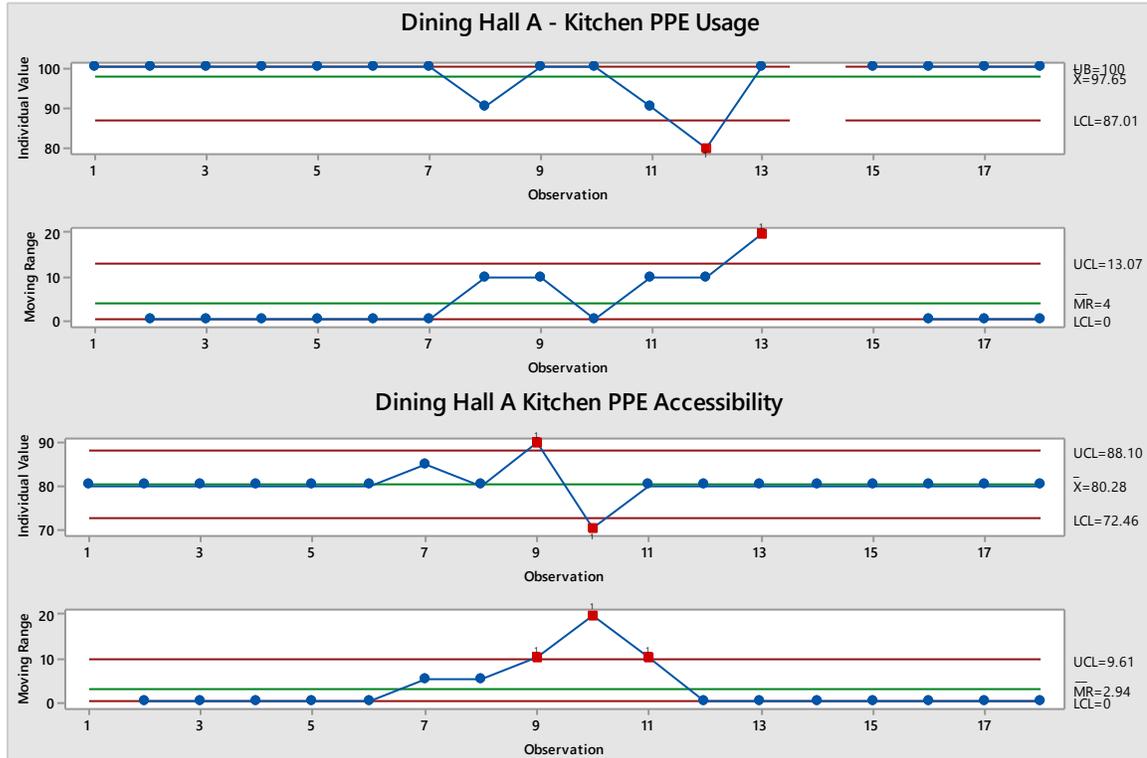
Figure 17 – Dining Hall A: Kitchen Area PPE Usage & Accessibility

The dining hall B overall kitchen score mean was 96.17 (UB=100, LCL=88.67). The process' performance is stable and in control as seen in Figure 18 – Dining Hall B: Overall Kitchen Scores. The control chart for floor cleanliness displays an in control process with a mean of 86.67 (UB=100, LCL=62.49). The counter cleanliness indicator had three out of control points that were farther than three standard deviations from the mean. The mean for the counter cleanliness indicator was 95 (UB=100, LCL=80.49). See Figure 19 – Dining Hall B: Kitchen Counter and Floor Cleanliness for indicator performance. The PPE usage and accessibility indicators both had a mean of 100 throughout the duration of the auditing process. Overall organization of the kitchen area was not stable and displayed an out of control process; the mean for the kitchen organization indicator was 95 (UB=100, LCL=80.49) See Figure 20 – Dining Hall B: Kitchen Organization.
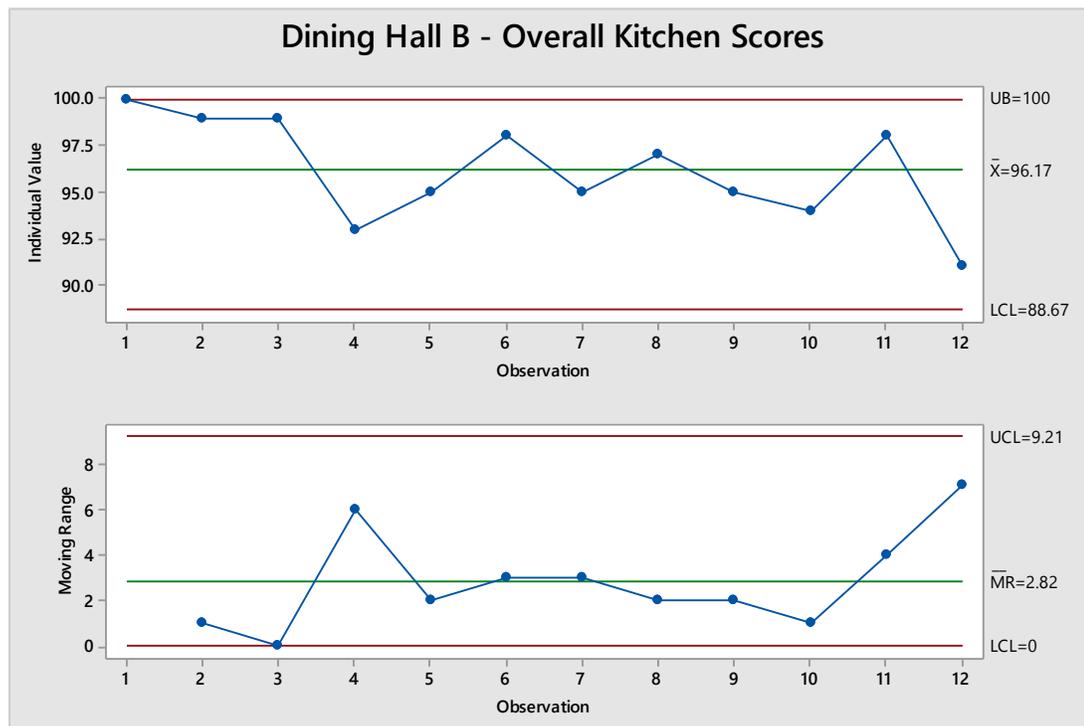
Figure 18 – Dining Hall B: Overall Kitchen Scores
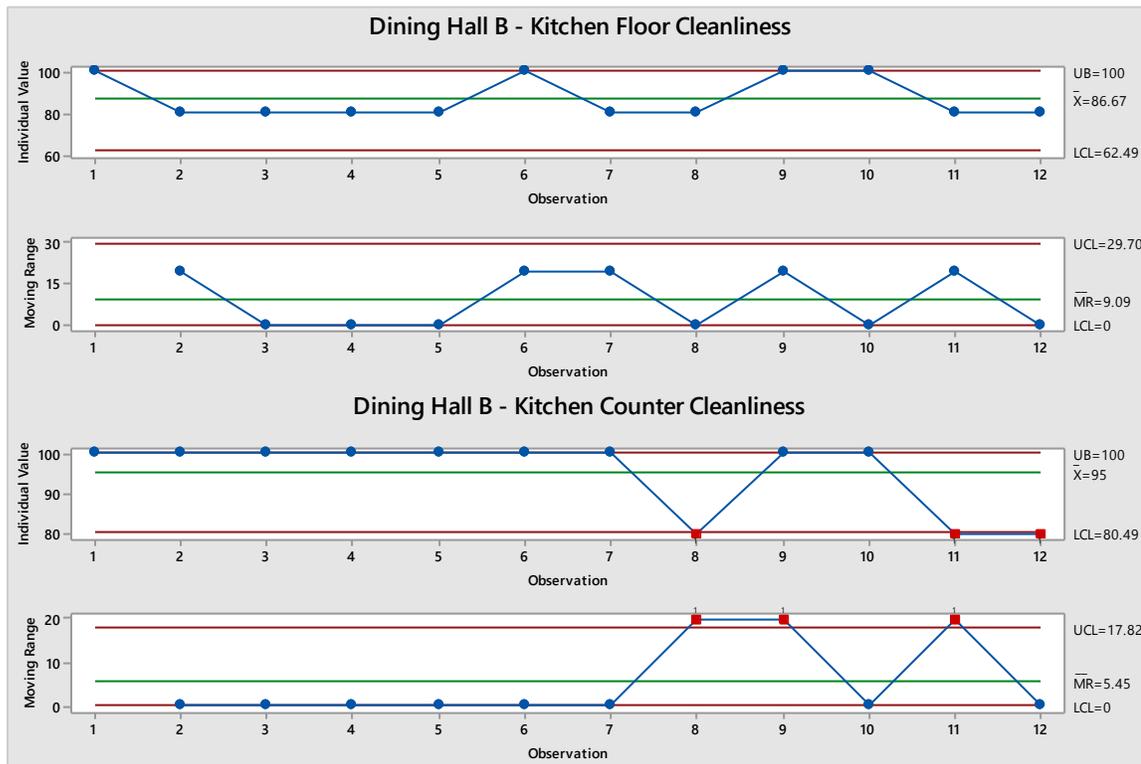
Figure 19 – Dining Hall B: Kitchen Counter and Floor Cleanliness
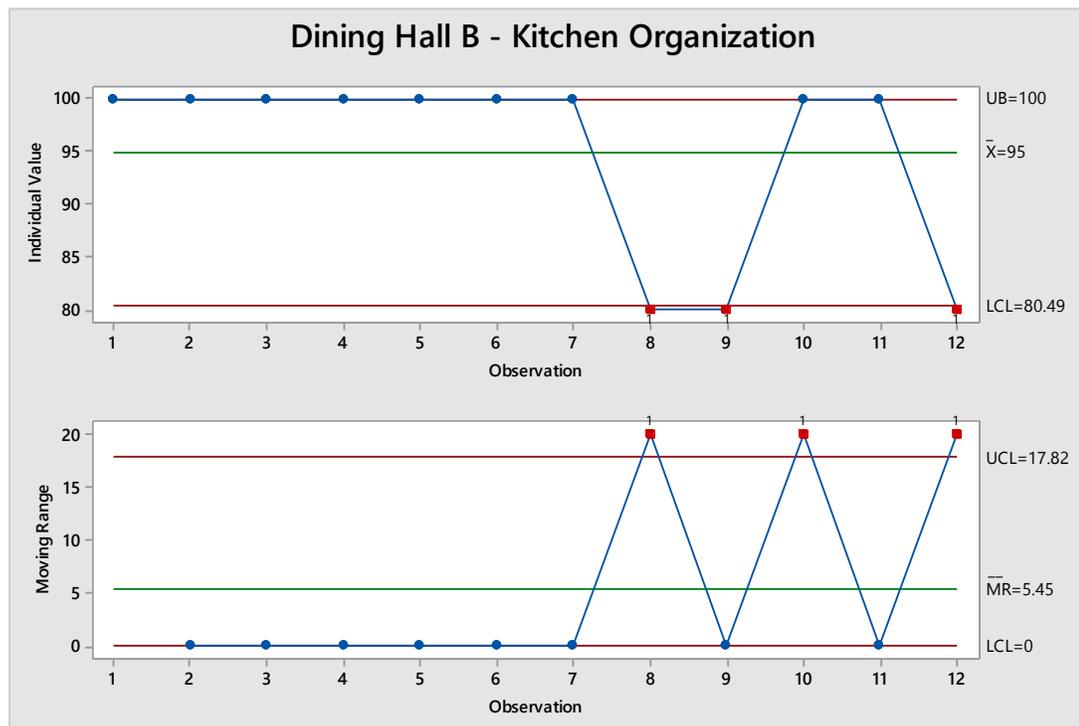
Figure 20 – Dining Hall B: Kitchen Organization

A capability analysis was only conducted on the overall kitchen scores for dining hall B because it was the only indicator or score to be normally distributed and display stable process performance. See Figure 21 – Process Capability Report – Dining Hall B: Kitchen Area for capability analysis results. The capability analysis yielded Cpk=1.91 and Ppk=1.95. Using 1.33 as an industry standard, this processes current and potential capability is able to meet the LSL of 80.

Process Capability Report for Dining Hall B Kitchen Area

Process Data	
LSL	80
Target	*
USL	*
Sample Mean	96.1667
Sample N	12
StDev(Overall)	2.75791
StDev(Within)	2.82122

Overall
Within

Overall Capability	
Pp	*
PPL	1.95
PPU	*
Ppk	1.95
Cpm	*

Potential (Within) Capability	
Cp	*
CPL	1.91
CPU	*
Cpk	1.91

	Observed	Performance Expected Overall	Expected Within
% < LSL	0.00	0.00	0.00
% > USL	*	*	*
% Total	0.00	0.00	0.00
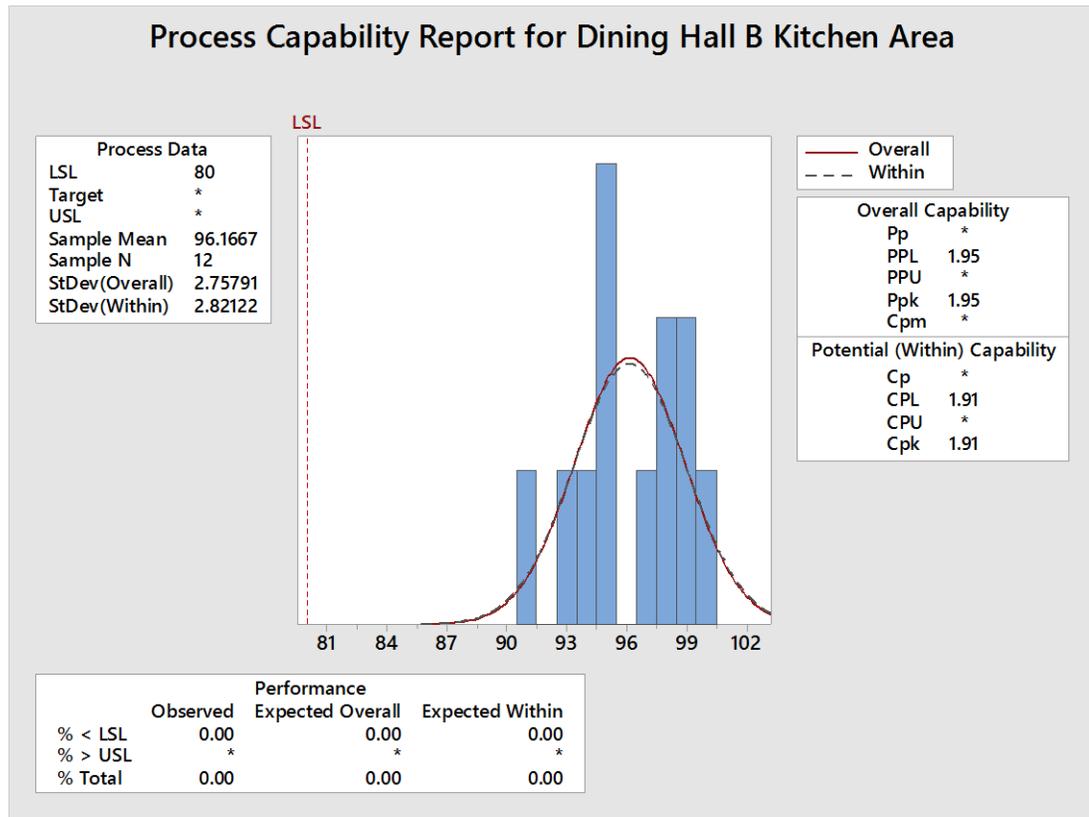
Figure 21 – Process Capability Report for Dining Hall B: Kitchen Area

4.2.5.5 Dishwashing Area

The dishwashing area for dining hall A is different than dining hall B in the fact they store their surplus PPE in the dishwashing area. Due to this difference in PPE storage, dining hall A will have indicators for the dishwashing area that dining hall B will not. Dining hall B dishwasher area score mean was 93.17 (UB=100, LCL=86.13). The process performance, as shown in Figure 22 – Dining Hall A: Overall Dishwashing Scores, is out of control with one point greater than 3 standard deviations from the mean.
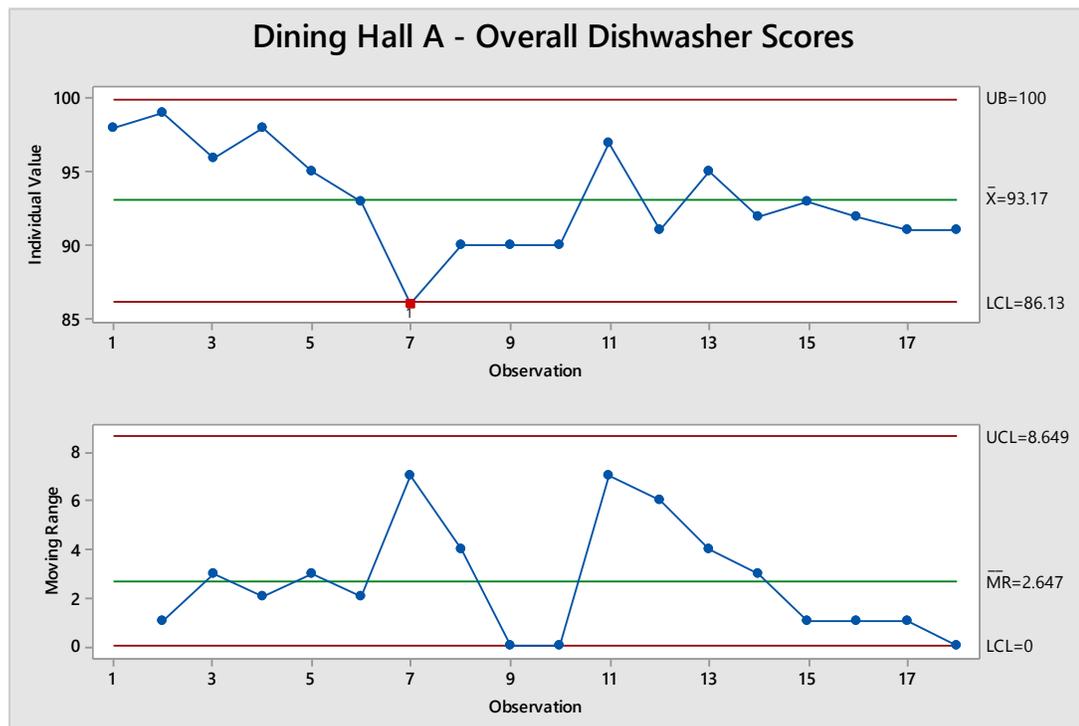
Figure 22 – Dining Hall A: Overall Dishwashing Scores

The dishwasher area floor cleanliness control chart returned a mean of 80.56 (UB=100, LCL=52.40). See Figure 23 – Dining Hall A: Dishwasher Floor Cleanliness for the I-MR control chart for the dishwashing area. The PPE accessibility indicator scored consistently apart from one out of control point, but the point was out of control above the range and mean. The mean for PPE accessibility was 80.56 (UCL=83.68, LCL=77.43). See Figure 24 – Dining Hall A: Dishwasher PPE Accessibility.
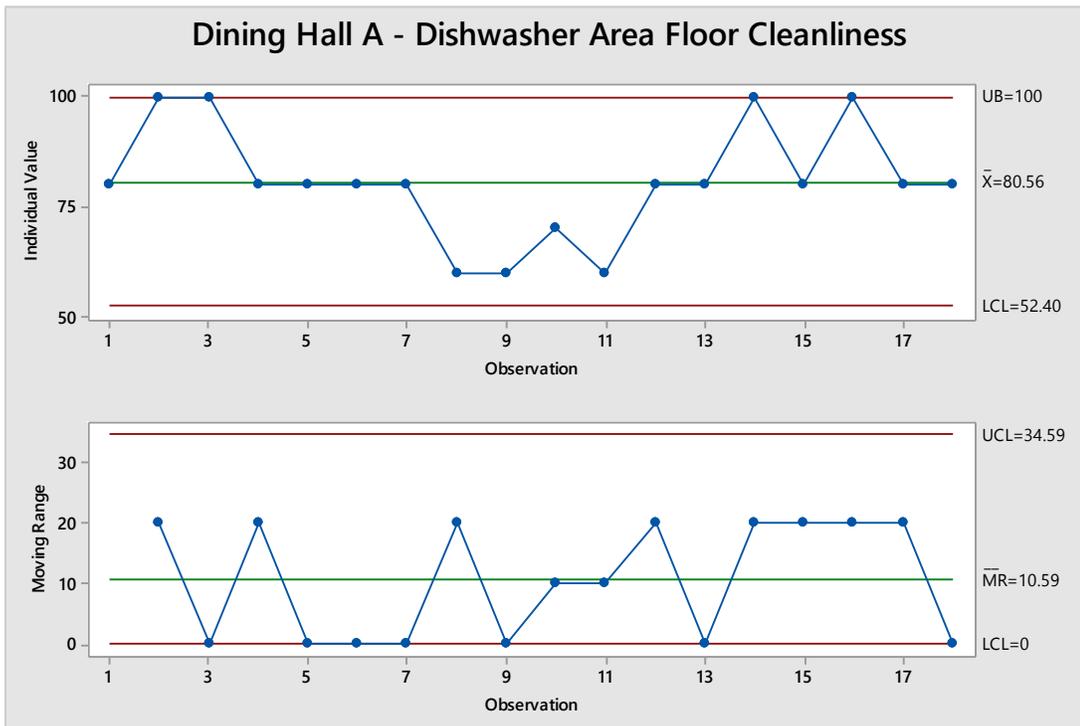
Figure 23 – Dining Hall A: Dishwasher Floor Cleanliness
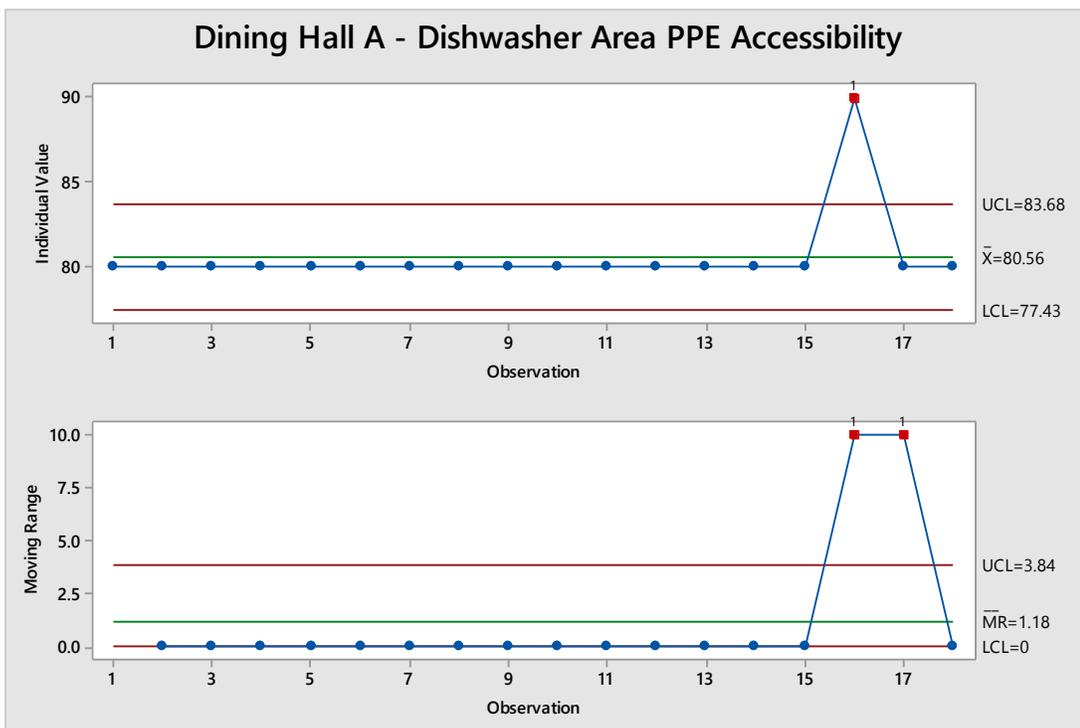
Figure 24 Dining Hall A: Dishwasher PPE Accessibility

A process capability analysis was conducted for the floor cleanliness indicator. A capability report was not created for the overall dishwashing score or other indicator scores because the process performance was not deemed in control. See Figure 25 – Process Capability Report for Dining Hall A: Dishwasher Area Floor Cleanliness for capability report results. The report returned Cpk and Ppk both at a value of 0.01, meaning it is incapable for its current and potential variation to reach the LSL of 80.
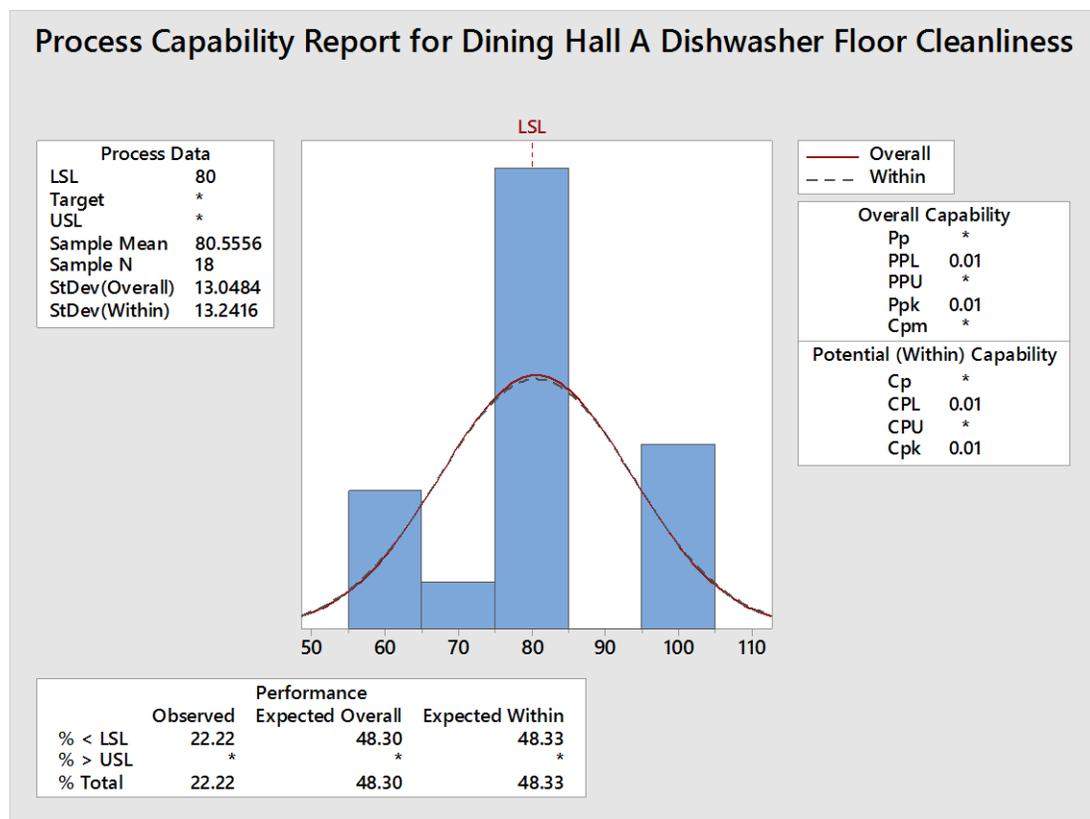
Figure 25 – Process Capability Report for Dining Hall A: Dishwasher Area Floor Cleanliness

The dishwasher area for dining hall B produced a mean of 85 (UB=100, LCL=45.11). The dishwasher area sub-scores when plotted on a control chart prove a stable and in-control process. See Figure 26 – Dining Hall B: Dishwasher Area Scores for process performance. The only other two indicator items for the

dishwashing area in dining hall B is floor cleanliness and the path of egress, as there is an emergency exit located in the dishwashing area.
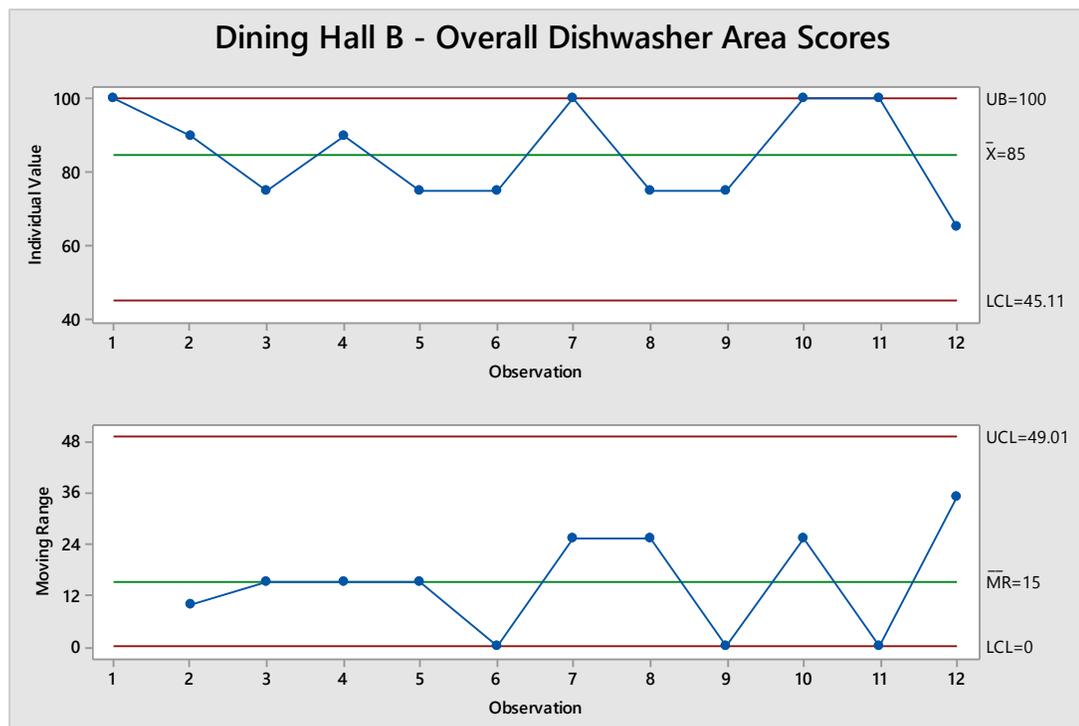
Figure 26 – Dining Hall B: Overall Dishwasher Area Scores

Floor cleanliness also produced a stable performance with the mean as 95 (UB=100, LCL=70.82). See Figure 27 – Dining Hall B: Dishwasher Floor Cleanliness. The control chart for the path of egress shows no special causes, displaying an in-control process. Path of egress process mean was 95 (UB=100, LCL=70.82). See Figure 28 – Dining Hall B: Dishwasher Area Path of Egress
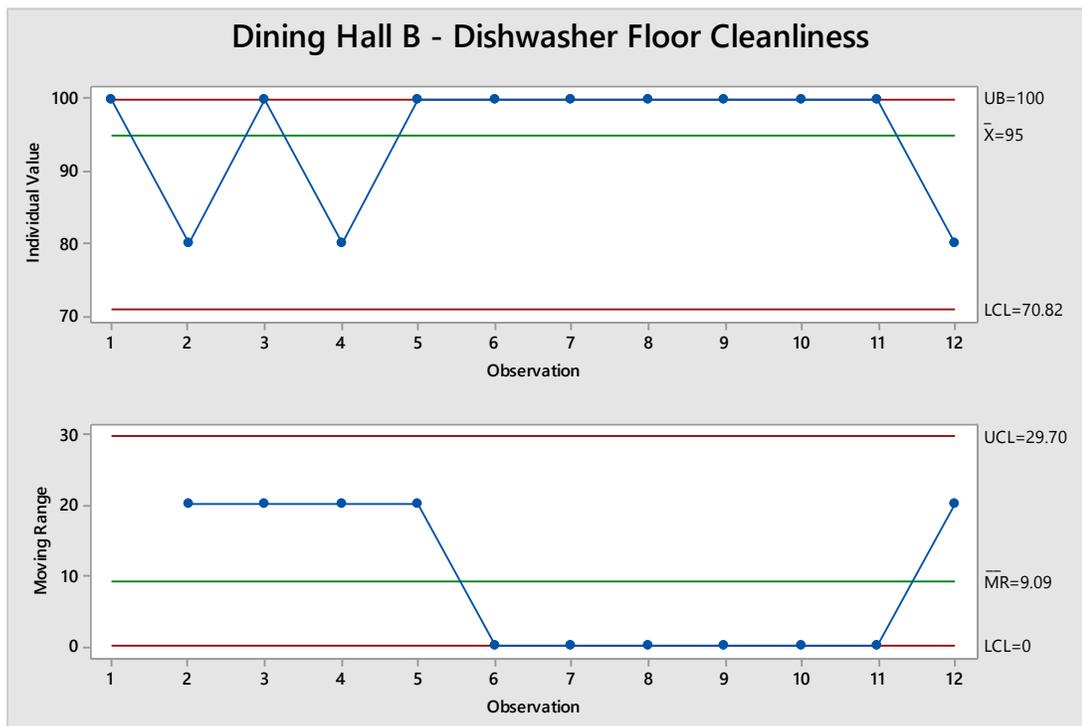
Figure 27 – Dining Hall B: Dishwasher Floor Cleanliness
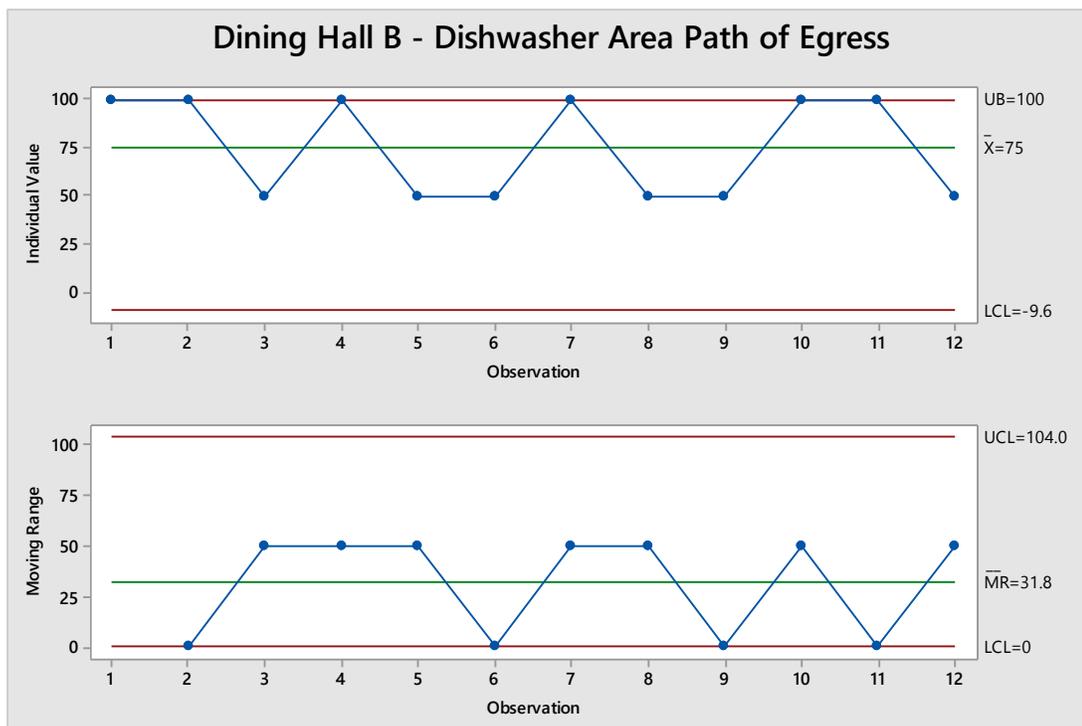
Figure 28 – Dining Hall B: Dishwasher Area Path of Egress

A capability analysis was conducted on all three of the above audit items; dishwasher area overall score, floor cleanliness, and path of egress. The overall dishwasher area presented Cpk and Ppk values of 0.13 for both capability values. Additionally, 50% of the data is below the lower specification limit set at 80. See Figure 29 – Process Capability Report for Dining Hall B: Dishwasher Area. The capability report for the dishwasher area floor cleanliness yielded Cpk and Ppk values of 0.54 and 0.55 respectively. The process cannot currently, nor does it have the potential to, meet specification limits. See Figure 30 – Process Capability Report for Dining Hall B: Dishwasher Floor Cleanliness. Finally, Cpk and Ppk values reported for the path of egress were -0.06 for both capability values. In addition to the low capability values, 50% of the data spread is below the lower specification limit at 80. See Figure 31 – Process Capability Report for Dining Hall B: Dishwasher path of Egress.
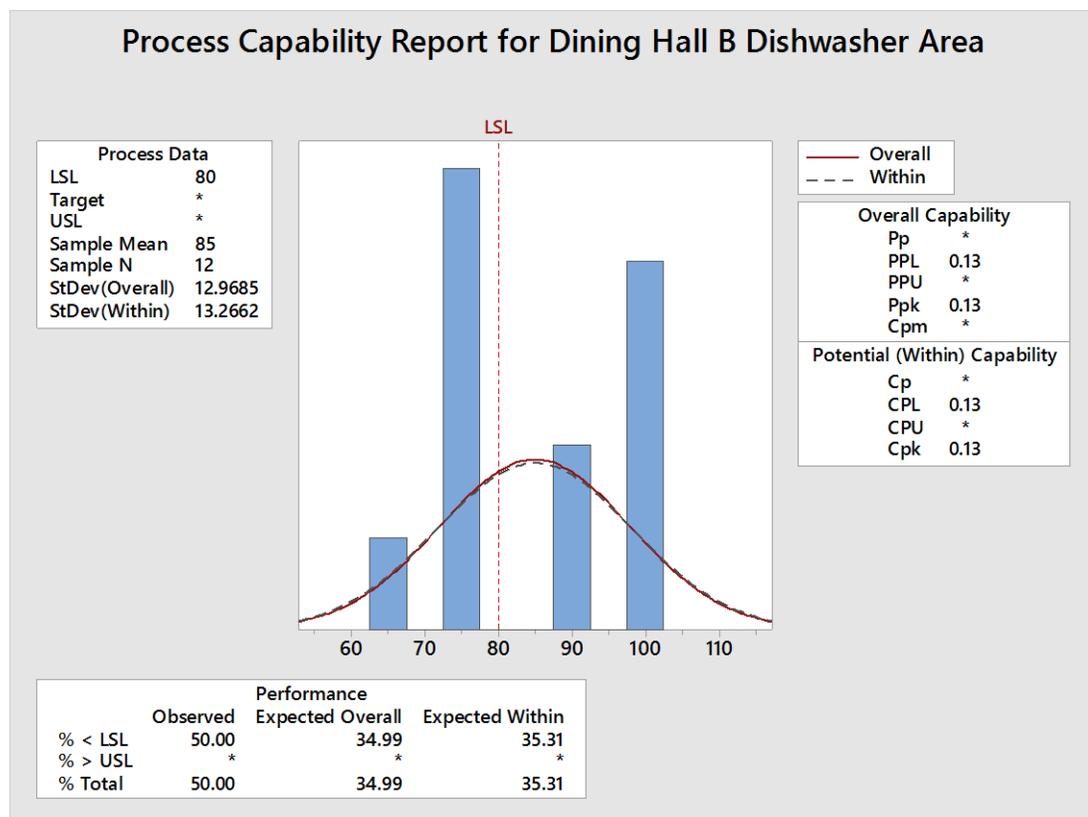
Figure 29 – Process Capability Report for Dining Hall B: Dishwasher Area

Figure 30 – Process Capability Report for Dining Hall B: Dishwasher Floor Cleanliness

Process Capability Report for Dining Hall B Dishwasher Area Path of Egress

Process Data
LSL   80
Target   *
USL   *
Sample Mean   75
Sample N   12
StDev(Overall)   26.1116
StDev(Within)   26.7111

Overall Capability
Pp   *
PPL   -0.06
PPU   *
Ppk   -0.06
Cpm   *

Potential (Within) Capability
Cp   *
CPL   -0.06
CPU   *
Cpk   -0.06

	Observed	Performance Expected Overall	Expected Within
% < LSL	50.00	57.59	57.42
% > USL	*	*	*
% Total	50.00	57.59	57.42
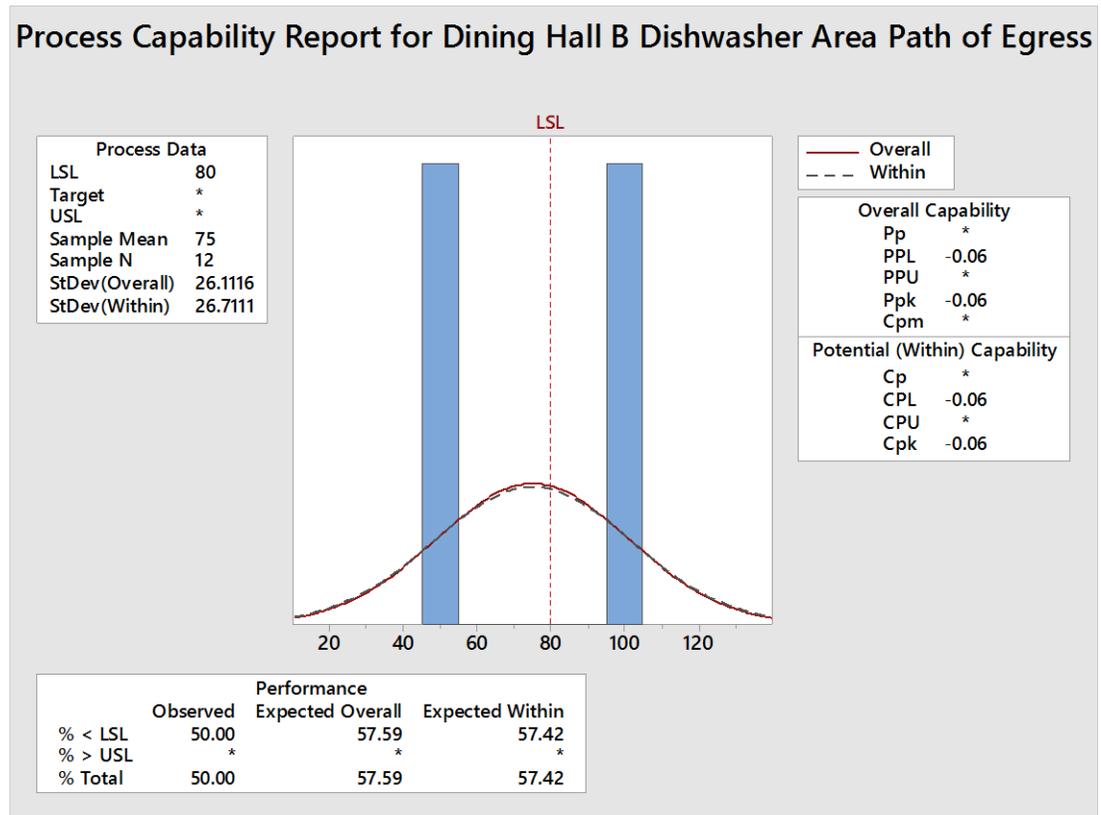
Figure 31 –Process Capability Report for Dining Hall B: Dishwasher Area Path of Egress

4.2.5.6 Concept (Serving Area)

The dining hall concept area is the front of the kitchen where food is transported from the kitchen to the front to be served to students and staff. The overall concept area performance resulted in a mean of 95.67 (UB=100, LCL=89.57). The process performance is stable and in control. See Figure 32 – Dining Hall A: Overall Concept Scores.
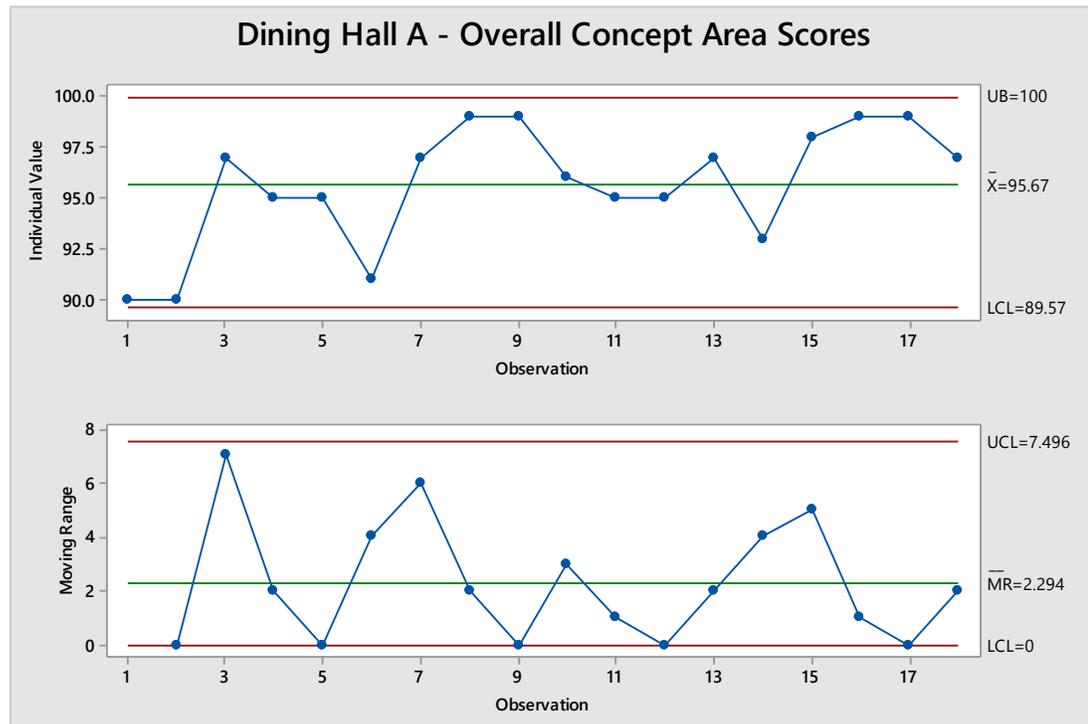
Figure 32 – Dining Hall A: Overall Concept Area Scores

Floor cleanliness for the concept area also had some common cause variation, but the process was still deemed stable by the control chart. The floor cleanliness mean was 95.56 (UB=100, LCL=73.65). See Figure 33 – Dining Hall A: Concept Floor Cleanliness. The results for PPE usage were consistent throughout the auditing process at a mean score of 100, but variation exists for PPE accessibility. The mean for PPE accessibility was 78.89 (UB=100, LCL=50.73). The I-chart for PPE accessibility is in control, but the moving range chart is not. Until the MR chart is also stable, the process is unstable and a capability analysis cannot be performed.
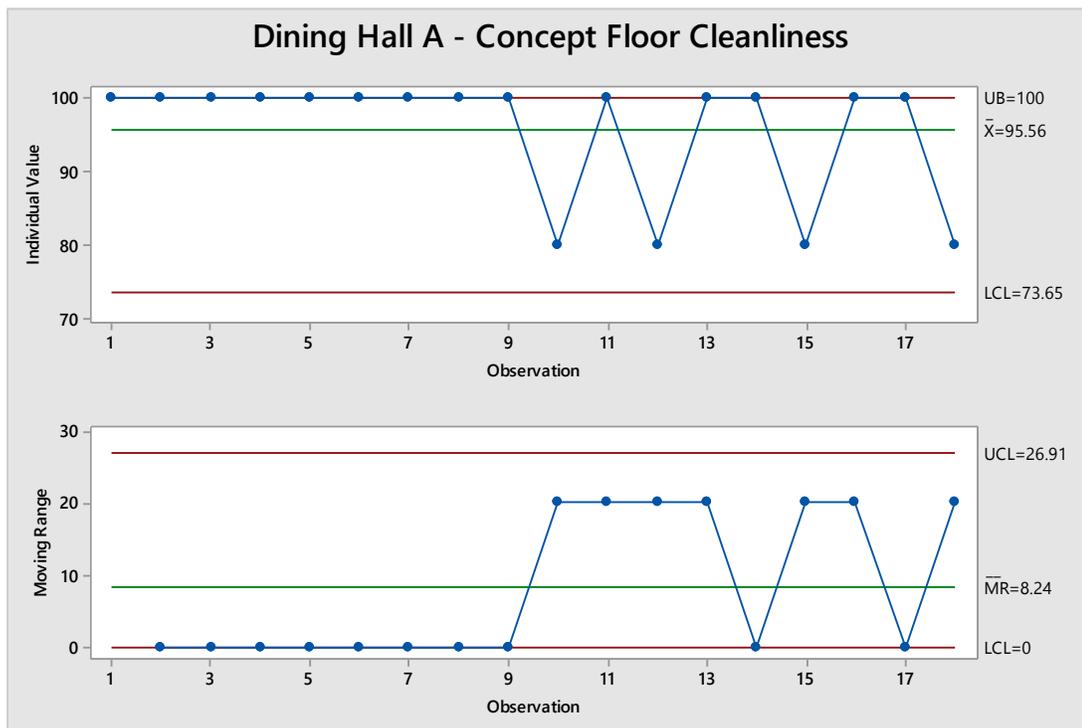
Figure 33 – Dining Hall A: Concept Floor Cleanliness
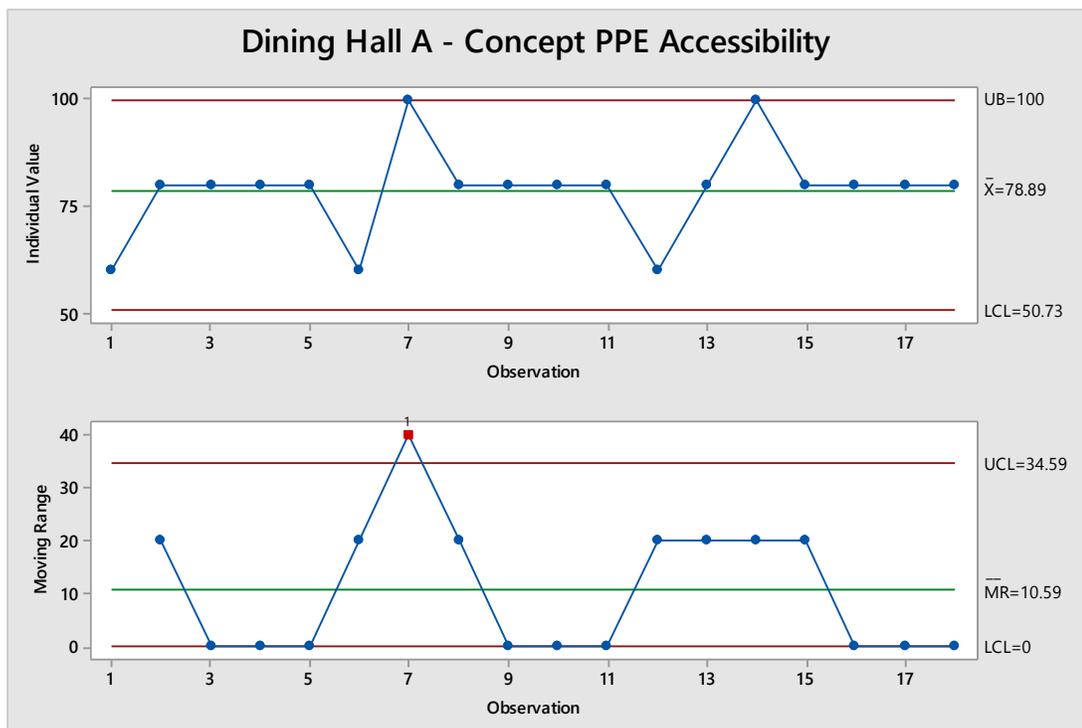
Figure 34 – Dining Hall A: Concept PPE Accessibility

A capability analysis was conducted on both the overall concept performance and floor cleanliness for the concept area. The overall concept performance produced a Cpk value of 1.72 and a Ppk value of 1.75. The process has the current and potential capability to meet the LSL of 80. See Figure 35 – Process Capability Report for Dining Hall A: Concept Area.
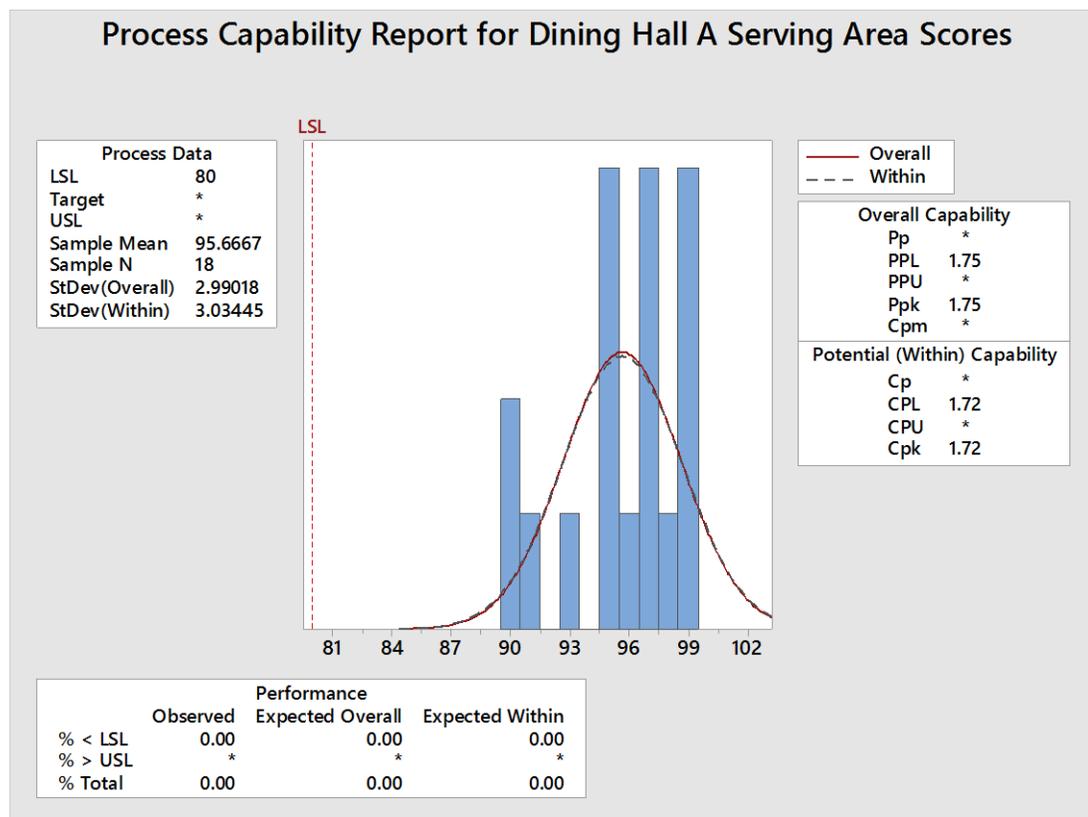
Figure 35 – Process Capability Report for Dining Hall A: Concept Area

The capability report for floor cleanliness in the concept area produced a Cpk value of 0.60 and a Ppk value of 0.61. Based on industry standards where Cpk and Ppk equal 1.33 as a threshold, the process does not have the capability to meet LSL for currently or potentially. See Figure 36 – Process Capability Report for Dining Hall A: Concept Floor Cleanliness.
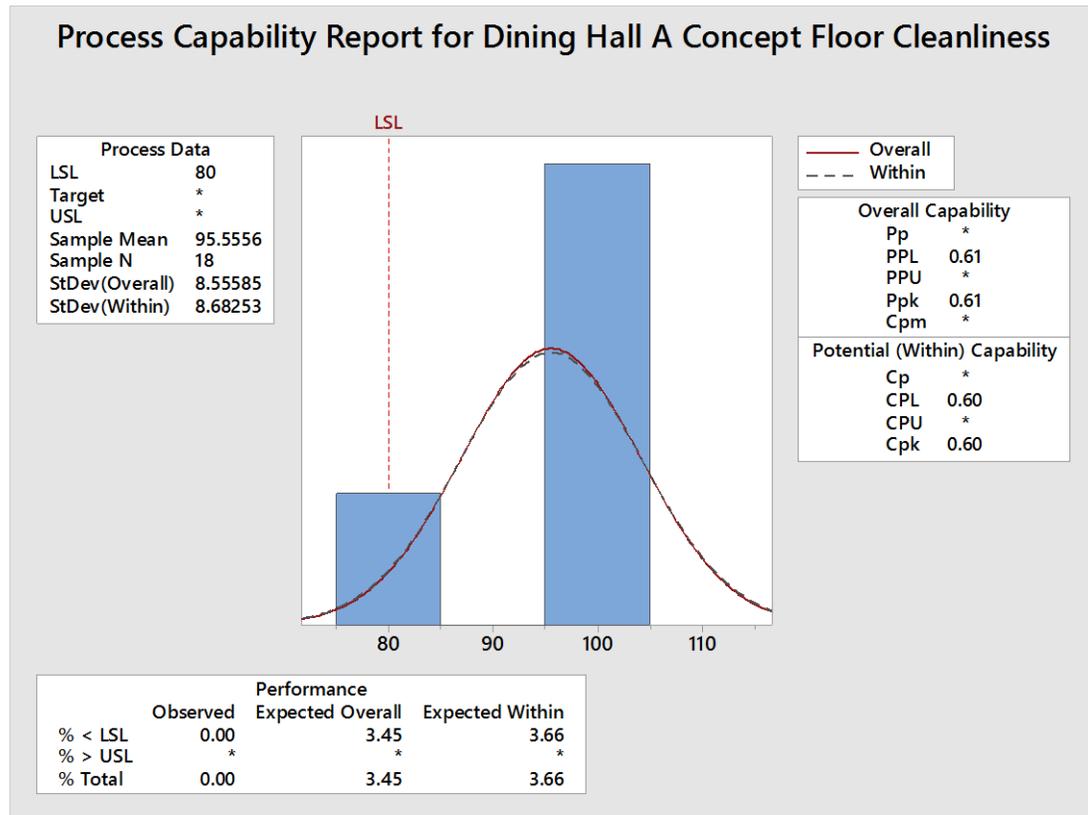
Process Capability Report for Dining Hall A Concept Floor Cleanliness

Process Data

LSL	80
Target	*
USL	*
Sample Mean	95.5556
Sample N	18
StDev(Overall)	8.55585
StDev(Within)	8.68253

Overall
— — Within

Overall Capability

Pp	*
PPL	0.61
PPU	*
Ppk	0.61
Cpm	*

Potential (Within) Capability

Cp	*
CPL	0.60
CPU	*
Cpk	0.60

Performance

	Observed	Expected Overall	Expected Within
% < LSL	0.00	3.45	3.66
% > USL	*	*	*
% Total	0.00	3.45	3.66

Figure 36 Process Capability Report for Dining Hall A: Concept Floor Cleanliness

Dining hall B had a mean just slightly less than dining hall A at 93.83 (UB=100, LCL=86.10). The process performance is stable with no out of control data points. See Figure 37 – Dining Hall B: Overall Concept Area Scores. Floor and counter cleanliness also had normal process variation, but no special causes. See Figure 38 – Dining Hall B: Concept Floor and Counter Cleanliness. Floor cleanliness resulted in a mean of 91.67 (UB=100, LCL=67.49), and counter cleanliness resulted in a mean of 95 (UB=100, LCL=70.82).
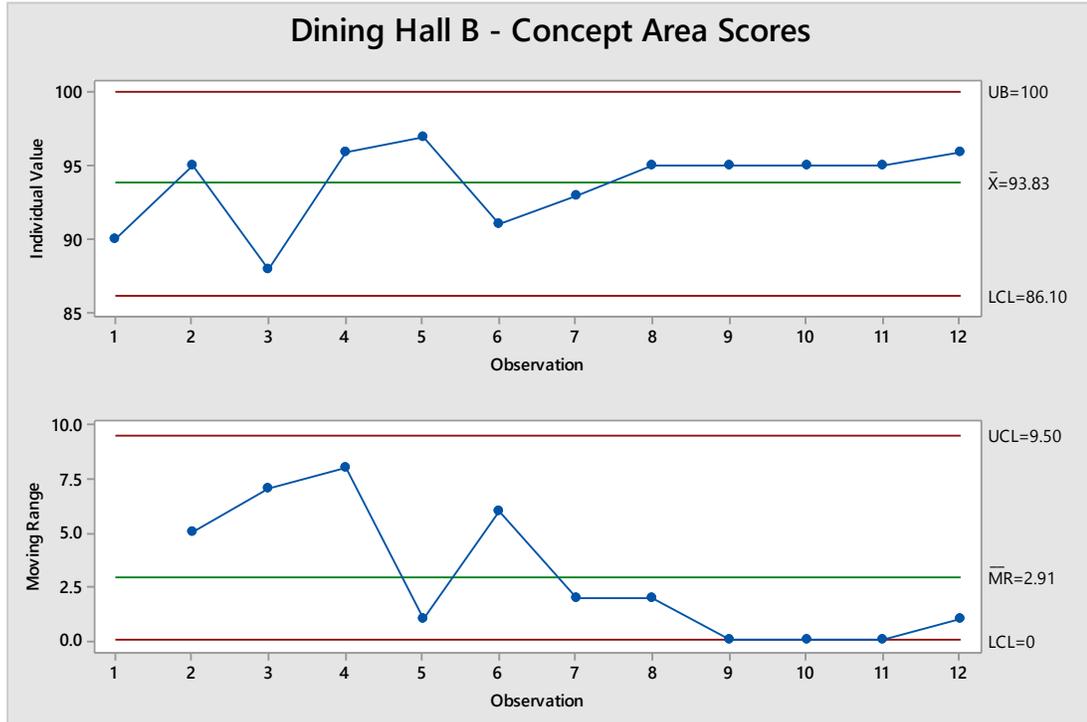
Figure 37– Dining Hall B: Overall Concept Area Scores
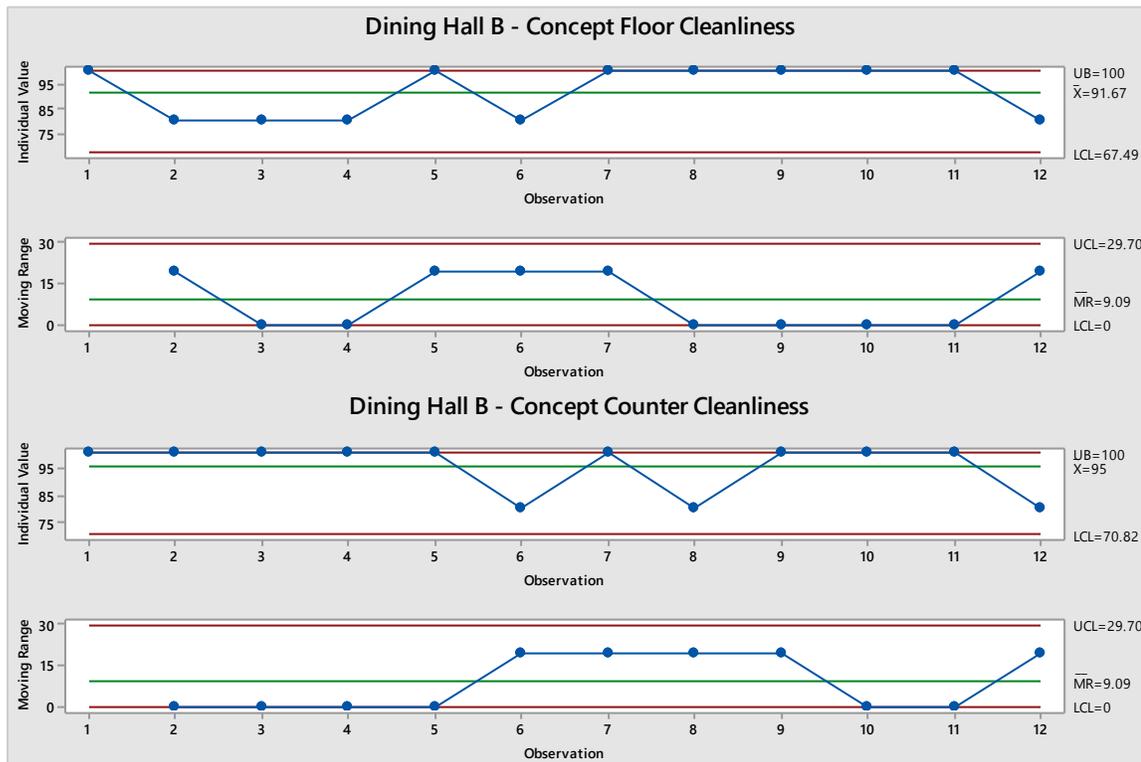
Figure 38 – Dining Hall B: Concept Floor and Counter Cleanliness

PPE accessibility held a constant score with the exception of one out of control point. See Appendix K for the Dining Hall B: Concept PPE Accessibility Control Chart. PPE usage however had more common variation than PPE accessibility, but still a stable process. The control chart shows a mean of 91.67 (UB=100, LCL=57.82). See Figure 39 – Dining Hall B: Concept PPE Usage.
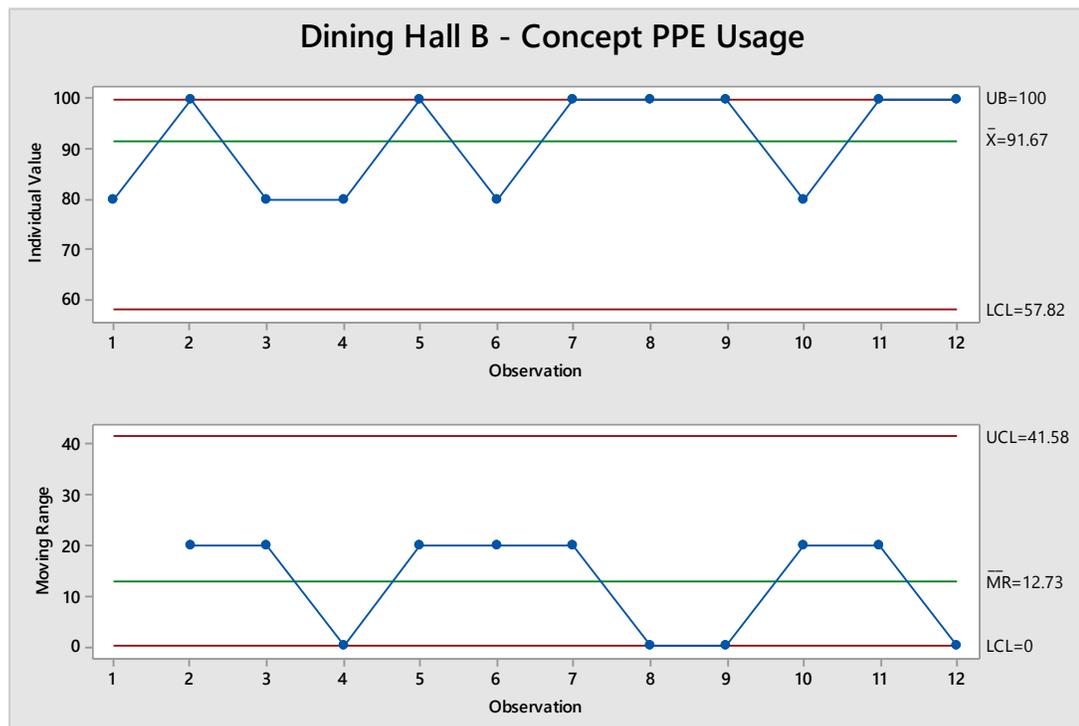
Figure 39 – Dining Hall B – Concept PPE Usage

A capability analysis was conducted on the overall concept performance, floor cleanliness, and PPE usage. See Figure 40 – Process Capability Report for Dining Hall B: Concept Area for report results. Overall concept performance on the capability analysis yielded a Cpk value of 1.63 and a Ppk value of 1.67. The process has both the current and potential capability of the process to meet the LSL of 80.
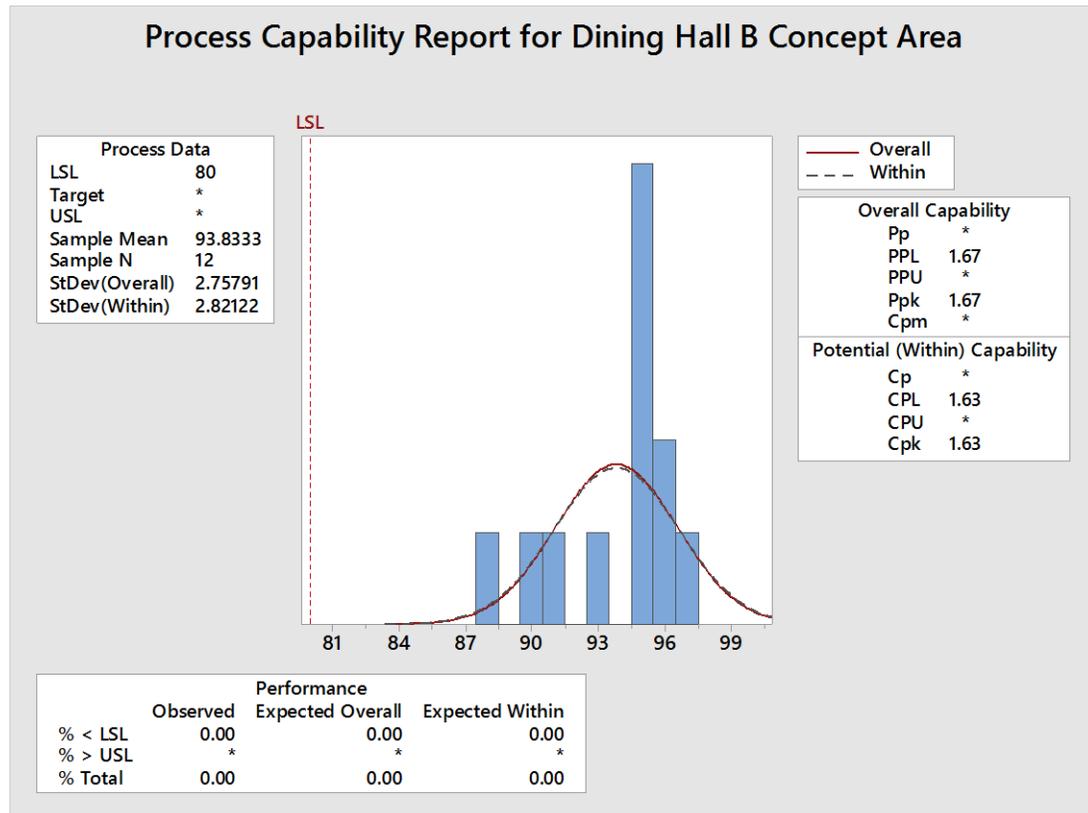
Figure 40 – Process Capability Report for Dining Hall B: Concept Area

However, the Cpk and Ppk values are much lower for the concept floor cleanliness capability analysis; Cpk was 0.37 and Ppk 0.38. Based on the industry standard for acceptable Cpk and Ppk values, the process does not have the capability to meet the lower specification limit now nor has the potential to if its current state continues. See Figure 41 – Process Capability Report for Dining Hall B: Concept Floor Cleanliness. Process Capability for PPE usage is also low, Cpk=0.37 and Ppk=0.38, indicating the process is incapable of meeting the specification limit currently and potentially in its current state. See Figure 42 – Process Capability Report for Dining Hall B: Concept PPE Usage.

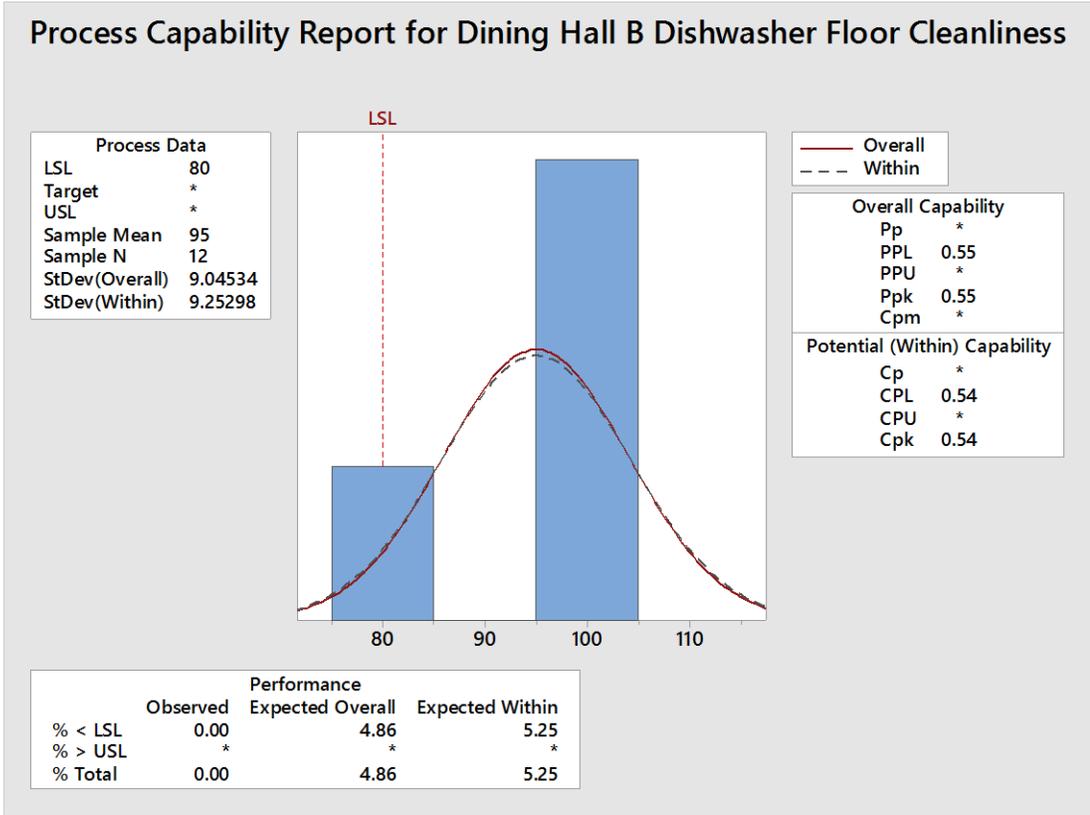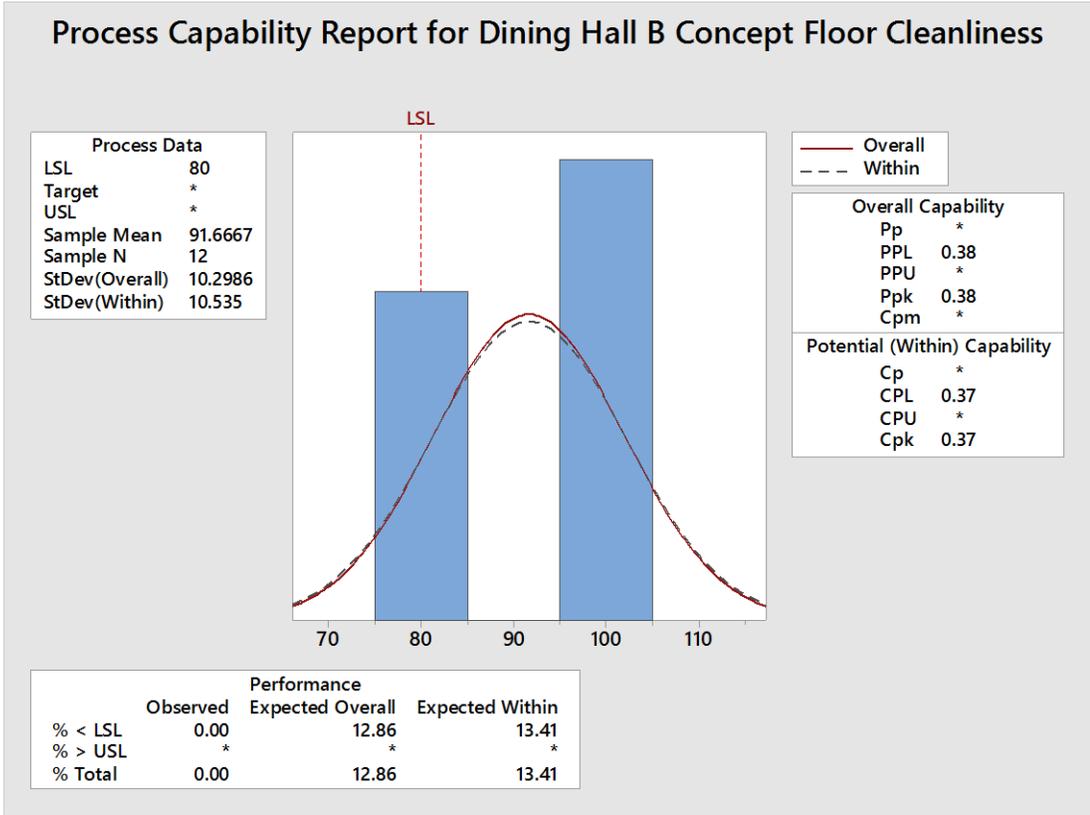*Figure 41 – Process Capability Report for Dining Hall B: Concept Floor Cleanliness*
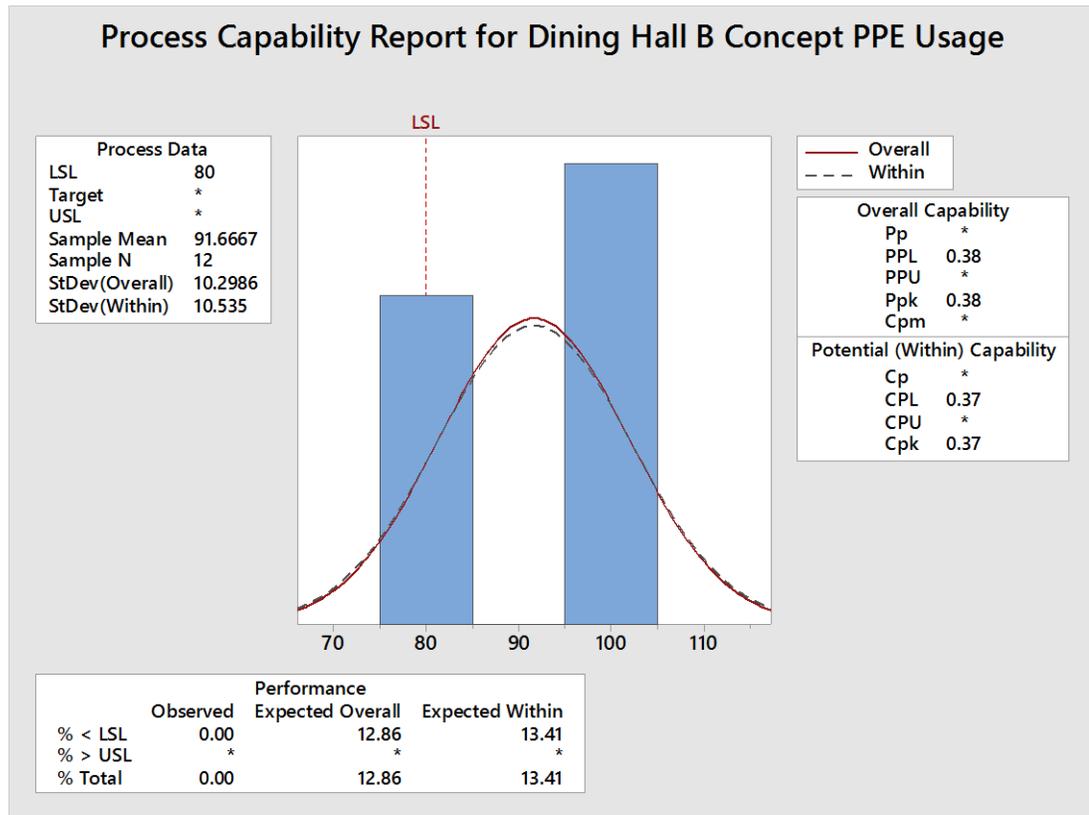
Figure 42 – Process Capability Report for Dining Hall B: Concept PPE Usage

CHAPTER 5: DISCUSSION

This study attempted to assess employees' individual risk awareness levels for their work environment and also use safety audits to assess safety processes and monitor leading indicators. Leading indicators are items that may potentially explain or predict the possibility of a future incident (Hinze et al., 2013). The connection between employees recognizing and acting on unsafe conditions and/or unsafe acts in their work environment, combined with monitoring safety processes and understanding work environment design can all be used to aid and plan for improvements that will help reduce occurrences of future incidents.

A pre-and post-risk awareness assessment was given to dining hall full time staff at the beginning and end of the data collection period. Two toolbox talks were conducted during the data collection period; the first on lifting safely and the second on recognizing unsafe conditions and unsafe acts. Completion of the assessments was completely voluntary and participants were not compensated for their time. There were 29 pre-risk awareness assessments completed and 16 post-risk awareness assessments.

Odds ratios from the pre-risk awareness assessments showed that employees at dining hall A are 2.1 times as likely to experience an incident or near miss than those at dining hall B, and are 2.33 times as likely to witness an incident or near miss than employees at dining hall B. Employees also reported common types of injuries for their work environment that aligned with the types of injuries that the Bureau of Labor Statistics reports for the eating and drinking industry. On the other hand, many employees could not, or simply did not, list a minimum of 5 hazards they are exposed to in their work environment or listed items that are not hazards (i.e. burns, gloves). It is worth noting that advanced improvements and education relating to occupational safety and the work environment if we, as safety professionals, cannot ensure the employees in our organization have mastered recognizing risk in the workplace. In this case, it is worthwhile to provide refresher training on basic safety foundation concepts.

Safety is not common sense and not everyone automatically works with safety first in mind, so continuous education on the subject is essential.

During the data collection period 30 audits were conducted between two dining halls; dining hall A and dining hall B. The audits were randomly scheduled with 6 audits being performed for every meal period each audit served. The design of the audits was based around leading indicators. The indicators were designed based on 4 categories of information from past incidents and their according incident report.

The main objective of this study was to connect a personal level of safety to process safety. In doing so, safety issues in the workplace can attempt to be resolved by addressing the issue from two sides. An independent samples t-test was performed on overall scores from the audits and found that the two dining halls indeed had significantly different scores. This process-based type of information paired with the information found from the risk awareness assessments tell us that not only are the safety processes and indicators different between the two dining halls, but that the risk for experiencing and/or witnessing an injury is higher in one dining hall. Additionally, 36% of participants from dining hall B said they had stopped a co-worker from performing a task because they were not wearing cut gloves, but dining hall B had consistently high scores for PPE accessibility. To connect these two bits of information, dining hall B experienced multiple cut type injuries during the data collection period. Thus, based on one source of information, especially if only process-based information about PPE accessibility was known in this situation, management and safety professionals would have no way of knowing the ongoing risks and behaviors relating to certain tasks that are always ongoing in the work environment.

Information collected from the risk awareness assessments can also be used for future training and help management address issues that may be contributing to unsafe acts or conditions. From the pre-assessment, 44% of respondents clearly stated that they rush more during their work and pay less attention to their surroundings when they are short-staffed. Employees know

exactly what causes them to sacrifice safety for production, but would never otherwise clearly state this to management when they are told they have to make up for additional work that needs done, whether it's for a sick co-worker or inefficient scheduling.

For the purpose of this study, safety audits were used as a snapshot in time of the work environment and risks and hazards present during that time. However, tasks and activities are cyclical. Safety audit data should be plotted and monitored to understand performance and its variation. Control charts were used to monitor process performance and variation as they allow you to see statistical changes in the performance. Shifts in performance can be identified, as well as any special or common causes that could be hinting at hidden problems. Low scoring areas or items help in identifying possibly poorly designed processes and the risks present in that process or area.

When studying the results for dining hall A's audits, a cyclical pattern started to emerge both based on what could be visually identified from the audits and control charts, but also based on personal experience of physically auditing the dining hall. Shelf storage ergonomics, floor cleanliness, and organization performance suffered in the freezer area most frequently, followed by the regular food supply storage room, and then the walk in refrigerators.

Inventory at dining hall A is replenished on a weekly basis; the first day that orders are shipped to the dining hall, scores for the above areas drop. Depending on what and how many of certain items were ordered, the effects of too much inventory may only affect the freezer area or may spread as far as all the storage areas. Thus, every week on the freezer scores you can see a drop in the overall scores and indicator items such as storage, floor cleanliness, and organization. Refer back to Figure 10 – Dining Hall A: Overall Freezer Scores and Figure 11 – Dining Hall A: Freezer Area Ergonomics. Points 3, 7, and 10 signify the day that inventory was received, and the following audit scores reflect a decrease in performance. Too much inventory and space limitations means high stacking of boxes, tripping hazards as items are stored on the floor instead

of shelving, and a drop in floor cleanliness because storage areas are filled with pallets and full boxes. It may take a few days for areas to be cleared of clutter before wood pallet pieces can be cleaned from the floor. In the meantime, safety is affected for a few days a week in these areas.

It should be noted that an audit report was generated for each conducted audit and sent to dining hall management on a weekly basis. To-do items were tracked and included on audit reports to ensure that immediate hazards were corrected and followed up on. See Appendix M and N for examples of condensed and expanded audit reports that were sent to management on a weekly basis.

How safety audits and their corresponding data were used in this research is proof of a concept of how audits can be applied to track data and performance relative to safety metrics. The design of a safety audit directly affects the type of information and data ultimately recorded, and also what kind of analysis can be used with that data. Therefore, design of an audit is essential to its success and the results you can draw from the auditing process. It must also be noted that in the results of this research, overall scores for the entire audit and the sub-area that was audited were mostly high scores. For an audit to be successful and serve its purpose of identifying problem areas, it must identify and monitor specific indicator items. Sub-area scores are diluted with several indicator items. Not every indicator will perform poorly during every audit, thus poor performing items may be diluted by two, three, or more high scoring items. The only way to track specific poor performing processes is to also track their specific performance.

Capability analysis was conducted on indicator items and sub-areas that proved to be stable and in control. Capability analysis cannot be performed on processes that indicated the presence of special causes. The capability analysis helps to identify if the current performance and variation of a process will allow it to meet a specification limit at the present time, as well as its potential to meet the specification limit in the future based on its current performance. A lower specification limit of 80% was arbitrarily set. This additional analysis is essential

to proving if a process is even capable of meeting current or future performance goals. The capability analysis can aid in identifying and prioritizing in control processes for improvement activities. If a process is stable, but does not have the potential to meet specification limits for the future (Cpk<1.33), it should become a high priority for improvement activities.

5.1. Limitations and Lessons Learned

This research was conducted in the field and with that type of research design and environment comes unexpected roadblocks and limitations. The first set of limitations and lessons learned comes from the risk awareness assessments. A small sample size for the pre-risk awareness assessment, and an even smaller sample size for the post-risk awareness assessment made it difficult to do any kind of comparison between dining halls, as well as within the dining halls for a pre- and post- assessment into any possible changes the employees may have experienced relative to safety and risk awareness. Many of the assessment participants did not provide their names, which created an even smaller sample that could actually be used for any type of paired sample analysis. The participation rate was lower than anticipated for the risk awareness assessments. Additionally, student employees make up a large portion of the population in the dining halls and because of the amount of student employees and potential difficulty in scheduling and including them in the toolbox training, they were excluded from the research study. However, it should be noted that students themselves may be at a higher risk of injury due to inexperience and/or also being a working student, which presents its own difficulties and stressors. Simply because there are so many student employees does not make their safety training and education less important and they should be just as involved as full time staff in the continuance of safety training and education.

The purpose of this study was to design a safety audit around leading indicators that may potentially predict or explain the possibility of future injuries or incidents. That statement in mind, monitoring of such indicators and validating their true meaning and results takes time. The data collection for this study lasted

for 5 weeks. Ideally, more time would be needed to validate the indicators themselves, and then continue to fine tune the types of information that is collected for those indicators. Results, such as a decreased in injuries and illness, may take months or even a few years to truly show their effects from the monitoring and implemented improvements.

The design of the toolbox talks must be taken into consideration. Employees between organizations are not all the same, even further, individual differences are present between employees in the same organization. Toolbox talks are designed to informal training sessions, but they are still training material nonetheless. Locke and Latham's research on training transfer and training design methods should be researched and implemented when designing toolbox talks to ensure the material reaches the employee in the right manner so that they may transfer the material learned immediately to the workplace. Additionally, management should also be trained on how to properly deliver content and connect with their employees, not just on safety topics but also for other training purposes as well. One could say that training the trainer may be essential for these types of informal training scenarios.

Lastly, attention should be focused on the structure of the feedback mechanism from the safety audit results. The audit reports were meant to give a direct summary of the state of the dining halls to management. However, this portion of the study had no methodology to measure or assess how this feedback was used or acted upon by management. In a best case scenario, management would use this information to educate employees on safety in the workplace and help create responsibility and accountability within and between employees for workplace safety. Locke and Latham's research on goal setting theory would be an ideal body of knowledge to consult to create a construct that could directly assess feedback mechanisms for leading indicators.

CHAPTER 6: CONCLUSIONS

Results from the pre-risk awareness assessment and the safety audits connected patterns and issues from both the personal and process side of safety. Those at dining hall A are more likely to experience and witness an incident than those employed at dining hall B. Additionally, t-tests confirmed that the performance on the dining halls were statistically significant from each other. The assessments identified factors about the work environment and employee behavior that would have otherwise gone unnoticed from the audit process.

The design and indicators measured on the safety audits are imperative to their success and type of analysis that can be conducted on safety processes in the work environment. The monitoring and tracking of safety processes performance can key safety professionals and management in on low performing processes, indicate the occurrence of special causes, and elude to deviations in how employees are following procedures. Item and process performance may appear in a cyclical trend, such as the inventory ordering and control issue found in dining hall B. The effects of such an issue may spread throughout the department or organizations reach. Capability analysis allows for prioritization of process improvement activities and also provides information on the current and potential capability of a process to perform above a lower specification limit.

Overall, this methodology of selecting, designing, monitoring, and prioritizing improvement activities can be transferred to other areas and departments within the university. A standardization across department and areas also allows for a comparison of metrics for different areas across the organization; it would allow for an apples to apples comparison, instead of an apples to oranges scenario. Additionally, this methodology of choosing and implementing tracking of leading indicators is most practical in terms of a business model. Monitoring a specific set of leading indicators may eventually lead to a plateau in safety performance. Once a certain level of performance is reached, or other issues become more prominent relative to safety a

reassessment of key indicators should be performed to ensure that a specific and targeted focus is maintained on performance and improvements.

Within organizations, occupational safety often struggles with getting higher management or the c-suite to see the value in improving safety. A better safety program not only provides a safer work environment, but also cost avoidance and increased productivity. By monitoring performance and metrics in a way that other levels and disciplines within an organization can understand, occupational safety can be understood in a way that matters to others in an organization. In addition, it allows occupational safety professionals to make sound decisions and proposals for improvement activities using validated tools and statistical methods that ensure decision making is based upon facts and data. Health and Safety departments have their own processes, goals, costs, and are just as valuable to an organization's sustainability and success as the assembly lines or receiving department. Safety departments must establish a technical method to track performance and associated costs in a way that provides value to their own decision making, as well as to other levels within an organization.

CHAPTER 7: RECOMMENDATIONS

It is clear from the data collection results that dining hall A and dining hall B are different work environments relative to safety processes and how they are maintained. Additionally, from a personal perspective of physically conducting audits, there is a clear safety culture difference between the two dining halls. The dining halls operate within the same organization, though they are each their own facilities in terms of operation and production, they both have the same basic mission; to provide students with high quality meals and safety for their employees. The first recommendation is to standardize many of the safety processes between the dining halls. The dining halls operate within the same university, and students and staff sometimes temporarily or permanently transfer to other dining halls on campus. Employees should be able to transfer or work at every dining hall and encounter the same safety culture, processes, and dedication to maintain safety as a priority in the workplace. Having different dining hall locations does not minimize, reduce, or change the types or amounts of hazards and risks present in an eating and drinking service type of environment. Thus, maintaining the same standards, policies, and processes the same way between dining halls will allow for seamless changes or transitions in the future and will make monitoring and measuring metrics between dining halls much more efficient and effective.

The second recommendation includes the continuing of an auditing or safety metric program. For improvements to be made to a system or process, its current performance, or a baseline, must always be known. Performance metrics are essential because without them management can never know if an implemented change ever worked. Additionally, metrics and sound data allow management to make decisions on hard facts and proof. This type of planning and decision making prevents wasting resources on making changes or improvements where they might not be needed or are implemented in the wrong way.

The last recommendation includes the creation of a cross-auditing program. The dining halls do not have an existing established auditing program. The EHS department on campus conducts audits and walkthrough, but not on a regular enough schedule for performance data to be collected. The dining halls must take the step to maintain their safety metrics together. As it currently stands, there is no standardization between the dining halls. An initial cross-auditing program would benefit both dining halls by allowing employees and management to learn and help each other relative to a safety initiative. Management and staff from dining hall A would be responsible for auditing dining hall B, and dining hall B responsible for auditing dining hall A, and auditing should still be conducted within each dining hall for their own purposes. This cross auditing program will help the staff and management to bring ideas and information from their own dining hall to the others, while also collecting information and ideas from other dining halls and bringing them back to their own.

7.1 Suggestions for Further Development

The first suggestion for further research relates to the selection and implementation of key leading indicators. This study based selection on the previous year's injuries in relation to the most frequently occurring event or exposure, body part affected, nature of the injury, and the source of injury or illness. A different set of selection criteria, or using incident reports from a greater number of years, may affect the quantity and types of indicators chosen. It is important to focus on a select number of indicators. There are no best practices or research on the right type or number of indicators to be chosen or implemented. As with any database, the larger and broader it grows the more noise becomes a factor in focusing on key indicator results and relationships. How the indicators are monitored will also deeply affect the results of such implementation. Again, there are no best practices for monitoring leading indicators. Safety audits may not work well for every organization or the type of

indicator being used. Further research into how and what type of indicators are best paired with certain tools and industries needs to be investigated.

The type of analysis methods used on leading indicator data should be considered as a second suggestion for further research. Indicator data should be continuously collected and assessed, thus continuous improvement tools and analysis methods would be an adequate start for further development. However, continuous improvement and quality tools were designed for, and are regularly used in, general industry such as manufacturing and distribution centers. These tools and analysis methods must be modified to meet the needs of occupational safety and health professions. Six Sigma tools should be further explored in order to identify how they can provide safety and health with an ongoing improvement methodology that will allow for a common language among safety and health professions, as well as greater integration in an organization's operations and cost models.

Further refinement is needed on the methodological approach of using control charts. The use of control charts in their traditionally intended design pose some complications when applying them to occupational safety processes. Out of control points above the UCL need to be studied in terms of how they affect the control chart and how they should be used in the analyses of processes. In regards to safety, out of control points above the UCL do not necessarily indicate bad performance because higher performance is a constant endeavor. The occurrence of these points needs to be studied further. It should also be noted that even though processes may be in control and stable, their performance may still be poor. Further research is needed on how to demonstrate the stability of a process in addition to its level of performance.

The last suggestion is relative to the toolbox talks. Timing and planning presented themselves as an issue in this study. As a result, not enough data was collected after the last toolbox talk to perform any kind of analysis on the results. However, even with limited data it appeared that the means increased and the control limits decreased towards the mean on some of the control charts. Further

research needs to be conducted and established on the effects of informal toolbox training on safety process performance.

REFERENCES

A Case Study : Six Sigma Tool Usage. (2005). *Professional Safety*, *50*(6), 44–46.

Adams, S. (2003). Costs Drive Safety Training Needs. *HR Magazine*, *48*(1), 63 – 66.

Agraz-boeneker, R., Groves, W. A., & Haight, J. M. (2007). An Examination of Observations and Incidence Rates for a Behavior Based Safety Program. *The Journal of SH&E Research*, *4*(3).

Allford, L., & Carson, P. (2011). Toolbox Talks. *Loss Prevention Bulletin*, (220), 14–19.

Ateekh-ur-Rehman, L. U. R. (2012). Safety Management in a Manufacturing Company: Six Sigma Approach. *Engineering*, *04*(07), 400–407. http://doi.org/10.4236/eng.2012.47053

Blair, B. E., & Seo, D. (2007). Safety Training Making the connection to high performance. *Professional Safety*, *52*(10), 42–48.

Brahmasrene, T., & Smith, S. (2009). The Influence of Training, Safety Audits, and Disciplinary Action on Safety Management. *Journal of Organizational Culture, Communications and Conflict*, *13*(1), 9–20.

Brinia, V., & Efstathiou, M. (2012). Evaluation of factors affecting training transfer on safety in the workplace: a case study in a big factory in Greece. *Industrial and Commercial Training*, *44*(4), 223–231. http://doi.org/10.1108/00197851211231496

Bush, D., Paleo, L., Baker, R., Dewey, R., Toktogonova, N., & Cornelio, D. (2009). Restaurant Supervisor Safety Training : Evaluating a Small Business Training Intervention. *Public Health Reports*, *124*, 152–159.

Carson, P., & Snowden, D. (2010). Health , safety and environment metrics in loss prevention – part 1. *Loss Prevention Bulletin*, (212), 11–16.

Constructing a Control Chart (U-Chart) for Injury Rates. (2006). *Professional Safety*, (8), 6–8.

Eames, P. (2013). Are you in control of process safety ? Basis of safety assurance can provide the answer. *Loss Prevention Bulletin*, (231), 23–28.

Elefterie, L. (2012). Risk Assessment Audit versus Work Accidents Prevention. *Contemporary Readings in Law and Social Justice*, *4*(2), 552–561.

Endsley, M. R. (1995). Toward a Theory of Situation Awareness in Dynamic Systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32–64. http://doi.org/10.1518/001872095779049543

Floyd, A. L., & Floyd II, H. L. (2014). The value of vulnerability. *Professional Safety*, *59*(4), 32–37.

Hakkinen, K. (1999). Risk reduction within companies by a better understanding of safety. *Technology, Law & Insurance*, *4*(1/2), 51–54.

Hallowell, M. (2010). Safety risk perception in construction companies in the Pacific Northwest of the USA. *Construction Management and Economics*, *28*(4), 403–413. http://doi.org/10.1080/01446191003587752

Hinze, J., Thurman, S., & Wehle, A. (2013). Leading indicators of construction safety performance. *Safety Science*, *51*(1), 23–28. http://doi.org/10.1016/j.ssci.2012.05.016

Hu, X., & Qu, X. (2014). An individual-specific fall detection model based on the statistical process control chart. *Safety Science*, *64*, 13–21. http://doi.org/10.1016/j.ssci.2013.11.010

Huang, Y.-H., & Brubaker, S. A. (2006). Safety Auditing: Applying Research Methodology to Validate a Safety Audit Tool. *Professional Safety*, *51*(1), 36–40.

Huang, Y.-H., Verma, S. K., Chang, W.-R., Courtney, T. K., Lombardi, D. a, Brennan, M. J., & Perry, M. J. (2012a). Management commitment to safety vs. employee perceived safety training and association with future injury. *Accident Analysis and Prevention*, *47*, 94–101. http://doi.org/10.1016/j.aap.2011.12.001

Huang, Y.-H., Verma, S. K., Chang, W.-R., Courtney, T. K., Lombardi, D. a, Brennan, M. J., & Perry, M. J. (2012b). Supervisor vs. employee safety perceptions and association with future injury in US limited-service restaurant workers. *Accident; Analysis and Prevention*, *47*, 45–51. http://doi.org/10.1016/j.aap.2011.11.023

Johnson, J. (2012). Small Haulers: Audits Help Raise Safety Awareness. *Waste and Recycling News*, *18*(3), 0011.

Jones, N. (2011). Kitchen hazards. *The RoSPA Occupational Safety and Health Journal*, (4), 11–15.

La Duke, P. (2010). The Changing Face of Safety Measurement. *Fabricating and Metalworking*, 18–19.

Larsson, J., Landstad, B. J., Wiklund, H., & Vinberg, S. (2011). Control charts as an early-warning system for workplace health outcomes. *Work*, *39*(4), 409–425. http://doi.org/10.3233/WOR-2011-1191

Lokkerbol, J., Schotman, M. a. M., & Does, R. J. M. M. (2012). Quality Quandaries: Personal Injuries: A Case Study. *Quality Engineering*, *24*(1), 102–106. http://doi.org/10.1080/08982112.2011.625521

Manuele, F. (2009). Leading and Lagging Indicators: Do they add value to the practice of safety? *Professional Safety*, *54*(12), 28–33.

Mayhew, C., & Quinlan, M. (2002). Fordism in the fast food industry: pervasive management control and occupational health and safety risks for young temporary workers. *Sociology of Health & Illness*, *24*(3), 261–284. http://doi.org/10.1111/1467-9566.00294

Morita, P. P., & Burns, C. M. (2011). Situation Awareness and Risk Management Understanding the Notification Issues. *Studies in Health Techonology and Informatics*, *164*, 372–376. http://doi.org/10.3233/978-1-60750-709-3-372

Naderpour, M., Lu, J., & Zhang, G. (2014). A situation risk awareness approach for process systems safety. *Safety Science*, *64*, 173–189. http://doi.org/10.1016/j.ssci.2013.12.005

Personick, M. E. (1991). Profiles in safety and health, eating and drinking places. *Monthly Labor Review*, *114*(6), 19–26.

Powell, M. (2012). Sustaining your safety sweep audit process: your audit data can be leveraged to positively impact important facets of your safety administration process. *EHS Today*, *12*, 35–36.

Prevetta, S. S. (2006). Charting Safety Performance. *Professional Safety*, (5), 34–41.

Rundmo, T. (1996). Associations between risk perception and safety. *Safety Science*, *24*(3), 197–209.

Safety first. (2014). *Smart Business Cleveland*, *25*(9), 22–23.

Schiava, A. R. (2014). Safety Audits as Leading Indicators. *Professional Safety*, *59*(4).

Schultz, G. (2014). The Holy Grail of Safety: A Single, All-Encompassing Safety Leading Indicator. *EHS Today*, *7*(2), 29–30.

Szumilas, M. (2010). Explaining Odds Ratios. J*ournal of the Canadian Academy of Child and Adolescent Psychiatry*, 19(3), 227–229.

Torres, K. (2007). Plant safety tuneup: make the most out of your safety audits by following up on findings and using your audit results to tune up your plant safety process. *Occupational Hazards*, *12*, 36.

Williamsen, M. M. (2005). Six Sigma Safety. *Professional Safety*, *12*(6), 41–50. http://doi.org/10.1109/MIA.2006.1678380

United States Department of Labor: Bureau of Labor Statistics. (2012). *Occupational Injuries & Illnesses & Fatal Injuries Profile.* Retrieved from http://data.bls.gov/gqt/InitialPage

APPENDIX A: SAFETY AUDIT

Dining Hall Safety Audit Form

DATE/TIME:_____

Storage Area #1 (Back corner closet):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris, trash or water	Floor is in excellent condition with no debris, water, or trash

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)
- Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Fire Safety - **Proximity of storage to ceiling** (sprinkler=18", non-sprinkler=24")
- Deduct 5 points for every stack of storage impinges on required minimum space

Tallies – No. of stacks of storage stacked too high	

Organization & Storage of materials/tools

3	4	5
Materials/tools are disorganized, cluttered & present hazards	Some materials/tools are not organized and may be difficult to find & use	Materials/tools are neatly organized, no clutter & can be easily found & accessed

Notes:

Dining Area/Drink Counters:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Counter cleanliness

2	3	4	5
Counter is covered in debris & condition is unacceptable	Counter is in poor condition & needs to be attended to	Counter is generally clean with just a few instances of debris or trash	Counter is in excellent condition with no debris, water, or trash

Path of Egress (Y/N)

	Exit 1	Exit 2	Exit 3	Exit 4	Exit 5
Location					
Exit signs visible					
Clear path to exit					

Fire Safety – Fire Extinguishers & Fire Alarm Pulls

1	3	5
Not visible or accessible, obstructed from view & reach	Visible, but obstructed from reach or access by items	Visible and not obstructed from reach

1. Fire extinguishers - Rate each fire extinguisher based on the scale above _if below 3_

1.)	2.)	3.)	4.)
Loc.	Loc.	Loc.	Loc.

2. **Fire pull stations -** Rate each emergency fire pull station based on the scale above **if below 3**

1.)	2.)	3.)	4.)
Loc.	Loc.	Loc.	Loc.

Notes:

Grab & Go:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Are **wet floor signs** present if water is on the floor?   Y   N   N/A

Counter/work area cleanliness

2	3	4	5
Counter is covered in debris & condition is unacceptable	Counter is in poor condition & needs to be attended to	Counter is generally clean with just a few instances of debris or trash	Counter is in excellent condition with no debris, water, or trash

PPE

1. **Employees using proper PPE** (cut gloves, burn sleeves)

2	3	4	5
11+ employees were not using PPE	6 to 10 employees were seen not using PPE	1 to 5 employees were seen not using PPE	All employees were seen using PPE

2. **Placement/visibility of PPE**

3	4	5
PPE is not clearly visible & not easily accessible	PPE is visible, but may be out of reach or difficult to get to	PPE is clearly visible & easily accessible

Chemicals

1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

Notes:

Pizza Concept:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Are **wet floor signs** present if water is on the floor?   Y   N   N/A

Counter/work area cleanliness

2	3	4	5
Counter is covered in debris & condition is unacceptable	Counter is in poor condition & needs to be attended to	Counter is generally clean with just a few instances of debris or trash	Counter is in excellent condition with no debris, water, or trash

PPE

1. **Employees using proper PPE** (cut gloves, burn sleeves)

2	3	4	5
11+ employees were not using PPE	6 to 10 employees were seen not using PPE	1 to 5 employees were seen not using PPE	All employees were seen using PPE

2. **Placement/visibility of PPE**

3	4	5
PPE is not clearly visible & not easily accessible	PPE is visible, but may be out of reach or difficult to get to	PPE is clearly visible & easily accessible

Chemicals

1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

   Notes:

Walk-in Freezer:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Ice build-up

1	3	5
Excessive ice-build up that makes work/movement dangerous	Moderate ice build-up that makes work or movement difficult	No ice build-up on floors

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)
- Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Notes:

Storage Area #2 (Chemical storage):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Chemicals
1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

Are **eye wash station** fluid bottles expired?   YES   NO

Storage Area #3 (Food supplies):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)
• Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Carbon Dioxide Tanks - All tanks must be capped & chained. Deduct 5 points for every tank that does not follow these guidelines.

Tallies – No. of tanks not properly capped or chained	

Walk-in Refrigerator #1:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)
Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Notes:

Walk-in Refrigerator #2 (Cooks Cooler):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)
Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Notes:

Walk-in Refrigerator #3 (Produce Cooler):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Shelf storage ergonomics - (heavier objects=waist level, lighter objects=lower or higher)

Deduct 2 points for every shelf that does not follow these guidelines

Tallies – No. of incorrectly stocked shelves	

Notes:

Kitchen (Prep/cook area):

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Are **wet floor signs** present if water is on the floor?   Y   N   N/A

Counter/work area cleanliness

2	3	4	5
Counter is covered in debris & condition is unacceptable	Counter is in poor condition & needs to be attended to	Counter is generally clean with just a few instances of debris or trash	Counter is in excellent condition with no debris, water, or trash

PPE

1. **Employees using proper PPE** (cut gloves, burn sleeves)

2	3	4	5
11+ employees were not using PPE	6 to 10 employees were seen not using PPE	1 to 5 employees were seen not using PPE	All employees were seen using PPE

2. **Placement/visibility of PPE**

3	4	5
PPE is not clearly visible & not easily accessible	PPE is visible, but may be out of reach or difficult to get to	PPE is clearly visible & easily accessible

Organization & Storage of materials/tools

3	4	5
Materials/tools are disorganized, cluttered & present hazards	Some materials/tools are not organized and may be difficult to find & use	Materials/tools are neatly organized, no clutter & can be easily found & accessed

Cart weight distribution (of carts in use)

	1	3	5
	Carts are overloaded & weight is poorly distributed	Carts are not overloaded, but weight may not be distributed evenly	Weight is evenly distributed & loaded properly
Tallies of each			

Chemicals

1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

Fire Safety – Fire Extinguishers & Fire Alarm Pulls

1	3	5
Not visible or accessible, obstructed from view & reach	Visible, but obstructed from reach or access by items	Visible and not obstructed from reach

2. **Fire extinguishers - Rate each fire extinguisher based on the scale above <u>if below 3</u>**

1.)	3.)	5.)	7.)
2.)	4.)	6.)	8.)

3. **Fire pull stations -** Rate each emergency fire pull station based on the scale above (including hood suppression) **<u>if below 3</u>**

1.)	3.)	5.)	7.)
2.)	4.)	6.)	8.)

Notes:

Dishwasher Area:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Are **wet floor signs** present if water is on the floor?   Y   N   N/A

Are water resistant mats present?   Y   N   N/A

Fire Safety – Fire Extinguishers

1	3	5
Not visible or accessible, obstructed from view & reach	Visible, but obstructed from reach or access by items	Visible and not obstructed from reach

1. **Fire extinguishers - Rate each fire extinguisher based on the scale above <u>if below 3</u>**

1.)	3.)	5.)	7.)
2.)	4.)	6.)	8.)

PPE – Placement/Visibility

3	4	5
PPE is not clearly visible & not easily accessible	PPE is visible, but may be out of reach or difficult to get to	PPE is clearly visible & easily accessible

Chemicals

1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

Notes:

Serving/Front End:

Floor Cleanliness

2	3	4	5
Floor is covered in debris & condition is unacceptable	Floor is in poor condition & needs to be attended to	Floor is generally clean with just a few instances of debris or trash	Floor is in excellent condition with no debris, water, or trash

Counter/work area cleanliness

2	3	4	5
Counter is covered in debris & condition is unacceptable	Counter is in poor condition & needs to be attended to	Counter is generally clean with just a few instances of debris or trash	Counter is in excellent condition with no debris, water, or trash

PPE

1. **Employees using proper PPE** (cut gloves, burn sleeves)

2	3	4	5
11+ employees were not using PPE	6 to 10 employees were seen not using PPE	1 to 5 employees were seen not using PPE	All employees were seen using PPE

2. **Placement/visibility of PPE**

3	4	5
PPE is not clearly visible & not easily accessible	PPE is visible, but may be out of reach or difficult to get to	PPE is clearly visible & easily accessible

Chemicals

1. **Chemical Labeling** - All bottles & cans must be clearly labeled. Deduct 5 points for every can/bottle not labeled or unreadable.

Tallies – No. of improperly labeled chemicals	

2. **Aerosol can caps** - All cans must have a cap. Deduct 5 points for every can without a cap.

Tallies – No. of aerosol cans with no caps	

Fire Safety – Fire Extinguishers & Fire Alarm Pulls

1	3	5
Not visible or accessible, obstructed from view & reach	Visible, but obstructed from reach or access by items	Visible and not obstructed from reach

3. **Fire extinguishers – Record each fire extinguisher based on the scale above <u>if below 3</u>**

1.)	2.)	3.)	4.)
Loc.	Loc.	Loc.	Loc.

4. **Fire pull stations -** Rate each emergency fire pull station based on the scale above (including hood suppression) **<u>if below a 3</u>**

1.)	2.)	3.)	4.)
Loc.	Loc.	Loc.	Loc.

Cart weight distribution (of carts in use)

	1	3	5
	Carts are overloaded & weight is poorly distributed	Carts are not overloaded, but weight may not be distributed evenly	Weight is evenly distributed & loaded properly
Tallies of each			

Notes:

Safety Presence in Work Area

1. Are safety & production goals displayed in work area?

2. How is a "Safety First" message conveyed in work area (signage, reminders, etc.)

Conversations with employees (additional info):

Immediate attention/Follow up items:

 *Follow up item(s) status will be tracked

Item	Defect/Reason

APPENDIX B: TOOLBOX TALK #1

Toolbox Talk #1

Topic: Lifting Safely

Content & Examples:

Lifting is part of our jobs every day, and something we do even when we are not at work. We are often so busy working towards production and focusing on completing the tasks at hand that we forget to approach lifting involved tasks with safety as a priority.

The risk of injury for lifting tasks can be attributed to how the task is designed or set up, how the task is completed by an individual, or a combination of the two. Injuries associated with lifting tasks included lower back injuries, strains/sprains, or intervertebral disc problems. There are many methods available to help you remember to perform lifting tasks safely and efficiently. Try committing the following two methods to memory when performing a lift task to help yourself and others avoid the potential for back injuries.

Lifting tasks are made up of two components:
1. Task design
2. Approach & execution of the task

Task Design

Lifting tasks should be designed with the following elements:
- Ideally, items should be between knee and shoulder level when lifting
- Avoid having heavy items stored in very high or low places
- Items more than 50 pounds should be lifted using two people
- Look into having specialized equipment (i.e. height adjustable kitchen carts) that can help minimize the stress of awkward positions or required forces.

Remember the "Size up the Area" method to assess and analyze how the task is set up and designed to avoid or minimize unsafe conditions.

Method 1:

Size up the Area
1. Analyze the situation & decide if you can reach the object safely at all. (Ex: If the object is above shoulder level & heavy, it may be best to have another person & use a sturdy stepladder to retrieve the object).
2. Decide if you can lift the object yourself or if you need assistance. When in doubt always ask for help!
3. Make sure the path you are taking with the lifted object is clear of obstacles and other hazards.

Task Execution

When performing a lifting task remember to:

- Align yourself in a neutral position and keep in-line with your shoulders, hips and feet.
- Do not twist or bend while performing a lifting task, as they creates a shearing force on the spine.
- Create a stable base with your feet
- Keep a stable grip on the object you are lifting
- Keep the load close to your body while lifting and carrying to avoid putting extra stress on the lower back.
  Remember the BACK acronym in order to continue to perform lifting tasks safely.
  Method 1:

BACK

Balance	Take a wide stance to create a stable base & have a stable grip on the object you are lifting.
Align	Align yourself in a neutral position. Make sure you do not twist or bend while lifting.
Close	Keep the load close to your body. More pressure is exerted onto your back when the load is held away from the body.
Keep it smooth	Keep your lifting motion smooth. Try not to stop and start or have jerky movements during the lift.

*Source: www.forestrymutual.com/lifting.htm

Thought Questions:

1. What do you think are some important lifting rules to remember?

2. Can you think of a lifting task(s) you perform at work that could be redesigned or changed to decrease the possibility of injuries and create a safer work environment? Please share your ideas!

Takeaway Points:

- Remember the **BACK** acronym & "**Size up the Area**" reminders to follow proper lifting techniques & assess task design

- Never be afraid to ask for help with a heavy lifting task.
- Share your ideas & input with management if you feel a lifting task is too dangerous to perform or could be redesigned to minimize potential risks and injuries. Everyone can contribute to a safe work environment!
- And remember, Safety First!

APPENDIX C: TOOLBOX TALK #2

Toolbox Talk #2

Topic: Unsafe Acts & Unsafe Conditions

Content & Examples:

Safety in the workplace is often approached with two factors in mind: unsafe acts & unsafe conditions. Unsafe conditions may present themselves at multiple times and areas in the work environment. A wet floor, broken equipment, or missing PPE are all examples of unsafe conditions. Unsafe acts can be linked to an individual's behavior and are how we may respond or react to an unsafe condition. Unsafe acts can often make an unsafe condition worse, thereby increasing the risk of injury or illness.

Try to relate to this example of how an unsafe condition and unsafe act can occur and feed into each other and increase the risk of injury for individuals:

Pots and pans are cleaned in the dishwashing area and are moved from the washing area to their appropriate shelving/storage location. In doing so, water drains and drips onto the floor from the washing area to the shelving unit. A main pathway from the dishwashing area to the kitchen is now covered in water (i.e. unsafe condition). Everyone is so busy completing their tasks that no one stops to put up wet floor signs or clean up the excess water. An employee who is focused on their task at hand and thinking about their four upcoming final exams doesn't notice the water on the floor. They are quickly walking through the area (i.e. unsafe act) and slips and falls twisting their ankle.

Minimizing and controlling for unsafe acts and unsafe conditions can help to create a work environment that is safer, but will contribute to productivity levels. Fewer injuries can lead to an increase in worker morale, cost savings for the organization, and a better, safer work environment for all employees. Try remembering or referring back to the following information on unsafe acts and unsafe conditions to minimize the potential for injuries in your work area.

Unsafe Conditions

It is essential to recognize and control for unsafe conditions in the work environment. The unsafe condition in the above example set the stage for a potential injury. Learning to identify unsafe conditions and the possible injuries that could be associated with them is a key part in minimizing workplace incidents.

1. **Identify Unsafe Conditions**

   Be aware & knowledgeable of the types of conditions and hazards in your work area & consistently be on the lookout for them.

   - Verify there are no **slips, trips, and fall** hazards such as water, oil, trash, or utensils on the floor.
   - Confirm that **personal protective equipment (PPE)** is available, in good condition, and appropriate for your work area.
   - Keep storage areas organized and design storage to follow ergonomic guidelines to minimize the risk of **strains and sprains.**
   - Verify machines, equipment, and tools are maintained and working properly to minimize the potential for **heat burns** or **cuts & lacerations**.
   - Use visual management to keep areas **organized**. There should be a place for everything, and everything in its place.

2. **Take Action**

   - If **immediate action** can be taken to minimize or fix the unsafe condition, then do so. Safety is everyone's responsibility and possibly overlooking an unsafe condition can put yourself and fellow coworkers at risk.
   - If an unsafe condition requires extensive action, such as a work order submission or changing how a work process is performed, **share ideas and information with management.**

Unsafe Acts

Unsafe acts are linked to behaviors and decision making and may be irrelevant to skill or experience level. By consistently and accurately identifying unsafe conditions, unsafe acts and behaviors can be adjusted accordingly. Even if an unsafe condition cannot be controlled or changed, a change in behavior can still minimize the risk for injury.

1. **Minimize Unsafe Acts**

   - Be aware of your surroundings
   - Understand & recognize how unsafe acts can lead to incidents – use your Safety Knowledge!
   - Help educate new employees in identifying and responding to unsafe conditions

2. **Correct Hazards**

   - Recognizing unsafe conditions and unsafe acts are valuable if they are corrected

- Report conditions to management
- Keep communicating with management to make sure hazards are corrected

Thought Questions:

1. What are some common unsafe conditions that occur in your work area?
2. Are there unsafe conditions in your work area that could be made worse by unsafe acts? Could they be fixed by performing safe acts or changing the work process?

Takeaway Points:

- Always perform safe acts, especially when unsafe conditions are present
- Report and share unsafe conditions with management and coworkers
- Verify that unsafe conditions or hazards are corrected when possible.
- And remember, Safety First!

Sources: "Hazard Recognition", "Hazard Assessment", "Housekeeping & Organization", "Unsafe Acts vs. Unsafe Condition" from www.safety.cat.com/toolbox

APPENDIX D: RISK AWARENESS ASSESSMENT

Risk Awareness Assessment

Please read before completing the assessment:

Your responses & identity for this assessment will be confidential. There are no right or wrong answers for this assessment. Please answer the questions honestly & to the best of your ability. As part of this study you will be asked to complete this same assessment again in 5 weeks at the end of the study. Information collected from this assessments will be used to increase risk awareness and hazard identification in employees. Once you have completed this assessment, write your name on the **inside** of the envelope this assessment came in and **seal it shut**. Return this envelope to the marked envelope in the General Manager's office, or directly to Ashley   Van Bibber (av200208@ohio.edu).

1. How long have you worked in your current job?

   _____

2. Are you a:
   a. Full time employee
   b. Part-time employee

3. How old are you? (please select from one of the categories)
   a. 18-19 years
   b. 20-24 years
   c. 25-34 years
   d. 35-44 years
   e. 45-54 years
   f. 55-64 years
   g. 65 and older

4. How would you say you feel about your job?

1	2	3	4	5
I strongly dislike my job	I don't like my job most of the time	I'm not sure	I like my job most of the time	I always love my job

5. What are the top 5 safety hazards in your work environment?

 1. _____

 2. _____

 3. _____

 4. _____

 5. _____

6. Can you name 4 types of injuries that commonly occur in your work environment?

 1. _____

 2. _____

 3. _____

 4. _____

7. Do you wear slip-resistant shoes?

 a. Yes

 b. No

 c. Sometimes

 If no, could you explain why

 _____

8. How often do you follow safety procedures when at work?
   a. I never follow safety procedures
   b. I sometimes follow safety protocol – it depends on how I feel that day
   c. I always follow safety rules
   d. I follow the safety procedures that I'm aware of, but I think I may not know all of them

9. Do you follow general safety rules when not at work? Such as, walking like a penguin on ice, using safety glasses at home, cutting items away from your body.
   a. I never follow safety procedures, no matter where I am at
   b. I sometimes follow safety protocol – it depends on how I feel that day
   c. I always follow safety rules, even at home

10. Have you ever stopped a co-worker from performing a task because they were not following safety procedures?
    a. No
    b. Yes

    Could you please explain why you did, or did not, stop the co-worker

    _____

11. Have you ever witnessed an incident or a near miss at your workstation or elsewhere while on the job?
    a. Yes
    b. No

12. How often do you think about safety while performing work tasks?

    a. I think about it all the time while working

    b. I sometimes think about it during my work

        day

    c. I hardly ever think about it while at work

13. Have you ever experienced an injury or a near miss while at work?

    a. Yes

    b. No

14. If you answered <u>YES</u> to question 13, did your experience change how you thought about safety in the workplace?

    a. Yes

    b. No

    c. I'm not sure

15. Do you feel that training & education relative to safety should be an essential part of your job training?

    a. Yes

    b. No

    c. I'm not sure

16. Have you ever recognized a potentially hazardous item or situation at work? (ex: a wet floor, damaged PPE, or broken equipment)

    a. Yes

    b. No

17. If you answered <u>YES</u> to question 16, did you notify a supervisor or team lead of the issue?

    a. Yes

    b. No

    If no, could you explain why?

    _____

18. Could you rate how dangerous you feel the health & safety risks are at your job is (circle one):

1	2	3	4	5
My job is not dangerous at all		My job is somewhat dangerous with moderate risks		My job is very dangerous that presents high or threatening risks

19. How often would you say you encounter hazards while working?

    a. On a daily basis

    b. On a weekly basis

    c. I don't encounter hazards while working

    d. I'm not sure

20. Could anything be done to make you feel safer while working & performing your responsibilities (ex: more or specialized training, personalized protective equipment (PPE))

    _____

    _____

    _____

    _____

APPENDIX E: DESCRIPTIVE STATISTICS FOR PRE-RISK AWARENESS ASSESSMENT

Dining Hall A & B: Descriptive Statistics			
Variable	N	Mean	Std. Dev
like job	29	4.2069	0.4123
wear non-slip shoes	29	1	0
follow work safety rules	29	3.1379	0.4411
follow safety rules at home	29	2.724	0.591
stopping co-worker from unsafe task	29	1.1034	0.3099
witnessed an incident/near miss	29	1.3103	0.4708
frequency of thinking safety	29	1.3103	0.4708
experience incident/near miss	29	1.4138	0.5012
necessity of safety training	28	1.214	0.63
awareness of hazardous situations	28	1.0357	0.189
notify mgt. of hazardous situations	27	1.1111	0.3203
job danger	27	2.815	0.879
encounter hazards frequency	27	2.259	1.196

Dining Hall A: Descriptive Statistics			
Variable	N	Mean	Std. Dev.
like job	10	4.2	0.422
wear non-slip shoes	10	1	0
follow work safety rules	10	3	0.471
follow safety rules at home	10	2.7	0.675
stopping co-worker from unsafe task	10	1	0
witnessed an incident/near miss	10	1.2	0.422
frequency of thinking safety	10	1.3	0.483
experience incident/near miss	10	1.3	0.483
necessity of safety training	10	1	0
awareness of hazardous situations	10	1	0
notify mgt. of hazardous situations	10	1	0
job danger	10	3	0.943
encounter hazards frequency	10	1.7	0.949

Dining Hall B: Descriptive Statistics			
Variable	N	Mean	Std. Dev
like job	19	4.1205	0.4189
wear non-slip shoes	19	1	0
follow work safety rules	19	3.2105	0.4189
follow safety rules at home	19	2.737	0.562
stopping co-worker from unsafe task	19	1.1579	0.3746
witnessed an incident/near miss	19	1.368	0.496
frequency of thinking safety	19	1.316	0.478
experience incident/near miss	19	1.474	0.513
necessity of safety training	18	1.333	0.767
awareness of hazardous situations	18	1.0556	0.2357
notify mgt. of hazardous situations	17	1.1765	0.393
job danger	17	2.706	0.849
encounter hazards frequency	17	2.588	1.228

APPENDIX F: PRE-RISK AWARENESS ASSESSMENT - HAZARDS AND
HAZARD THEMES

Hazard Themes from Pre-Risk Awareness Assessment - Dining Hall A and B
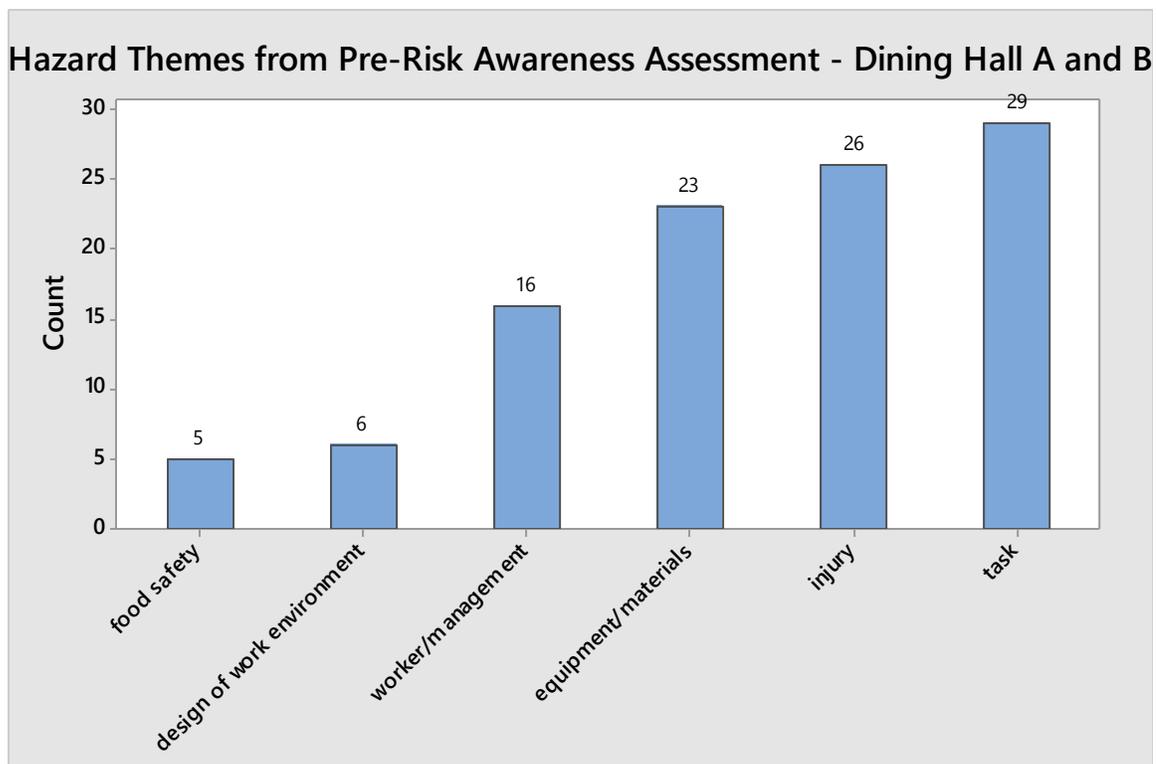
Listed Hazards	Frequency	Listed Hazards	Frequency
burns	10	overheating/heat exhaustion	2
kitchen carts	1	rushing	3
doors catching ankles	2	grills/steamers	6
cuts	4	cross contamination	3
grease	4	poor accountability	1
wet floor/spills	16	equipment	2
students	3	ice	1
knives/sharp tools	9	low fans in freezer	1
poor situation awareness	4	muscle sprains	1
short staffed	1	overstocked walk-in fridges	1
slips/falls	7	muscle sprains	1
hot pans	4	storage stacked too high	2
heavy physical workloads	9	food allergies	2
not wearing PPE	4	repetitive motion	1

APPENDIX G: PRE-RISK AWARENESS ASSESSMENT – LISTED INJURIES

Listed Injuries from Pre-Risk Awareness Assessment - Dining Hall A and B

Bar chart showing Count on the y-axis (0 to 25) versus injury type on the x-axis:
- Broken Dishes: 1
- Hot Pans: 1
- Hand/wrist Pain: 2
- Heat Exhaustion: 2
- strain/sprain: 2
- Heavy Lifting: 3
- Back Pain: 6
- Cuts: 21
- Slips/falls: 22
- Burns: 24
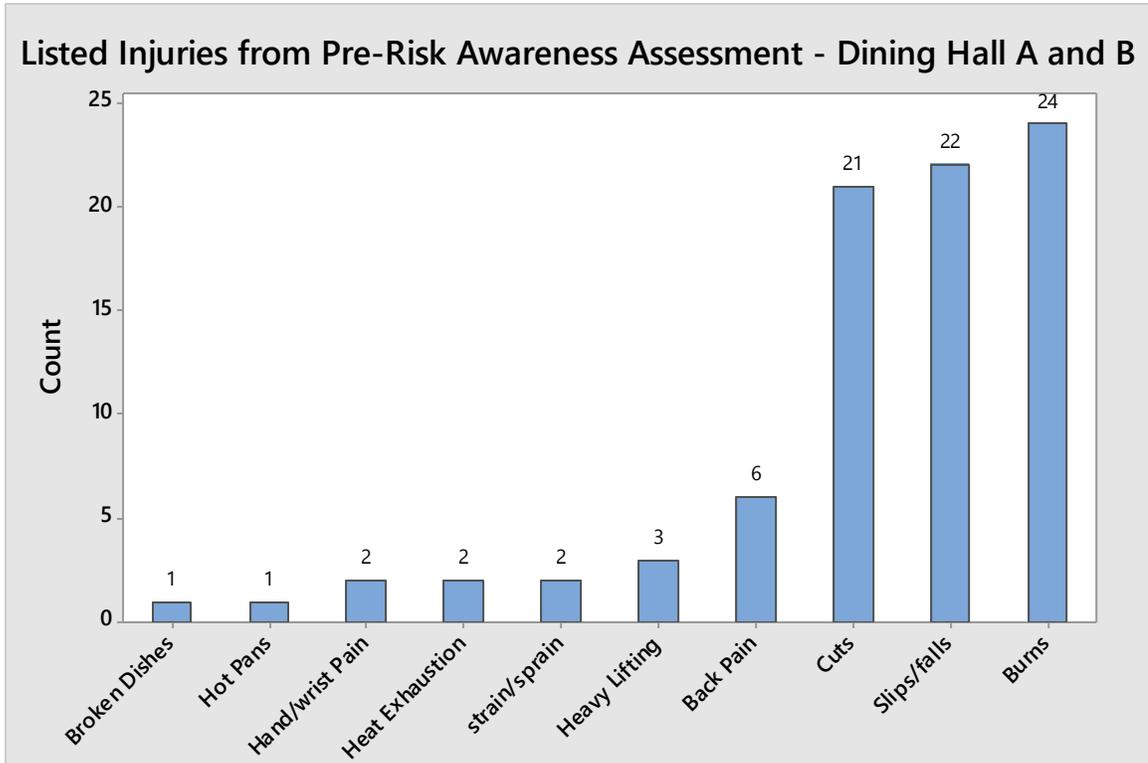
APPENDIX H: ODDS RATIOS

Binary Logistic Regression: experience incident versus dining hall							
Response Information				Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	1 (Yes)	17	(Event)	Dining Hall			
experience incident	2 (No)	12		A	B	2.1000	(0.4136, 10.6634)
	Total	29		Odds ratio for level A relative to level B			

Binary Logistic Regression: experience incident versus safety training							
Response Information				Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	1 (Yes)	17	(Event)	Training			
experience incident	2 (No)	12		Not sure	Yes	1.3333	(0.1062, 16.7431)
	Total	28		Odds ratio for level A relative to level B			

Binary Logistic Regression: experience incident versus training							
Response Information				Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	2 (No)	11	(Event)	Training			
experience incident	1 (Yes)	17		Not sure	Yes	0.7500	(0.0597, 9.4180)
	Total	28		Odds ratio for level A relative to level B			

Binary Logistic Regression: experience incident versus thinking about safety

	Response Information			Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	1 (Yes)	17	(Event)	Think Safety			
experience incident	2 (No)	12		Sometimes	All the time	0.8333	(0.1699, 4.0876)
	Total	29		Odds ratio for level A relative to level B			

Binary Logistic Regression: experience incident versus thinking safety

	Response Information			Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	2 (No)	12	(Event)	Think Safety			
experience incident	1 (Yes)	17		Sometimes	All the time	1.2000	(0.2446, 5.8861)
	Total	29		Odds ratio for level A relative to level B			

Binary Logistic Regression: witness incident versus thinking about safety

	Response Information			Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	1 (Yes)	20	(Event)	Think Safety			
experience incident	2 (No)	9		Sometimes	All the time	1.8846	(0.3052, 11.663)
	Total	29		Odds ratio for level A relative to level B			

Binary Logistic Regression: experience incident versus dining hall							
Response Information				Odds Ratios for Categorical Predictors			
	Value	Count		Level A	Level B	Odds Ratio	95% CI
Variable	1 (Yes)	20	(Event)	Dining Hall			
experience incident	2 (No)	9		A	B	2.3333	(0.3825, 14.233)
	Total	29		Odds ratio for level A relative to level B			

APPENDIX I: DESCRIPTIVE STATISTICS FOR AUDIT SCORES

Dining Hall B Descriptive Statistics					
Audit Area	**Mean**	**Std. Dev**	**Minimum**	**Median**	**Maximum**
Overall Score	94.58	1.68	92	94.5	97
Food Storage	81.50	3.61	76	81.5	86
Storage	97.50	1.31	96	97.5	99
Kitchen	96.75	2.09	93	96.5	100
Concept Area	93.67	2.74	88	95	97
Dishwashing	85.00	12.97	65	82.5	100
Freezer	90.67	7.15	80	86	100

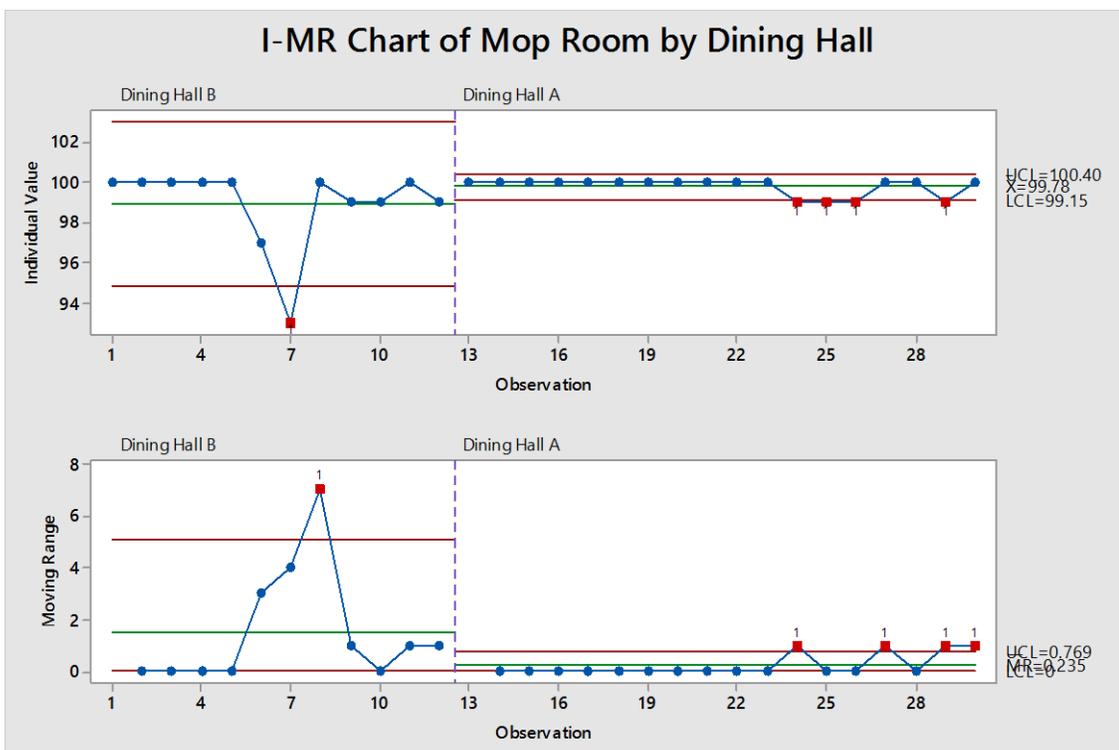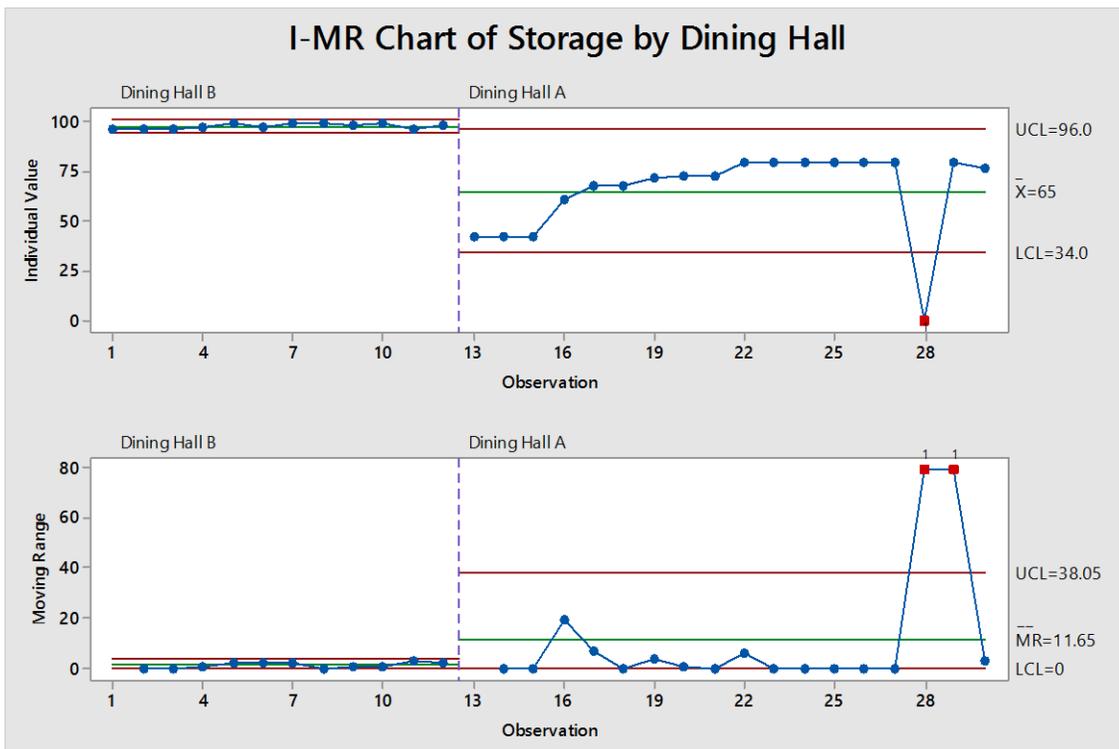| Dining Hall A Descriptive Statistics					
Audit Area	**Mean**	**Std. Dev**	**Minimum**	**Median**	**Maximum**
Overall Score	91.39	1.98	87	92	94
Food Storage	87.67	8.09	70	88	100
Storage	65.00	21.03	0	73	79
Kitchen	96.94	1.96	93	98	99
Concept Area	95.28	2.99	90	95.5	99
Dishwashing	93.50	3.57	86	93	99
Freezer	81.17	8.74	66	80	100

APPENDIX J: I-MR CONTROL CHARTS FOR AUDIT DATA

Dining Hall A - Kitchen Foor Cleanliness

Dining Hall A - Kitchen Counter Cleanliness
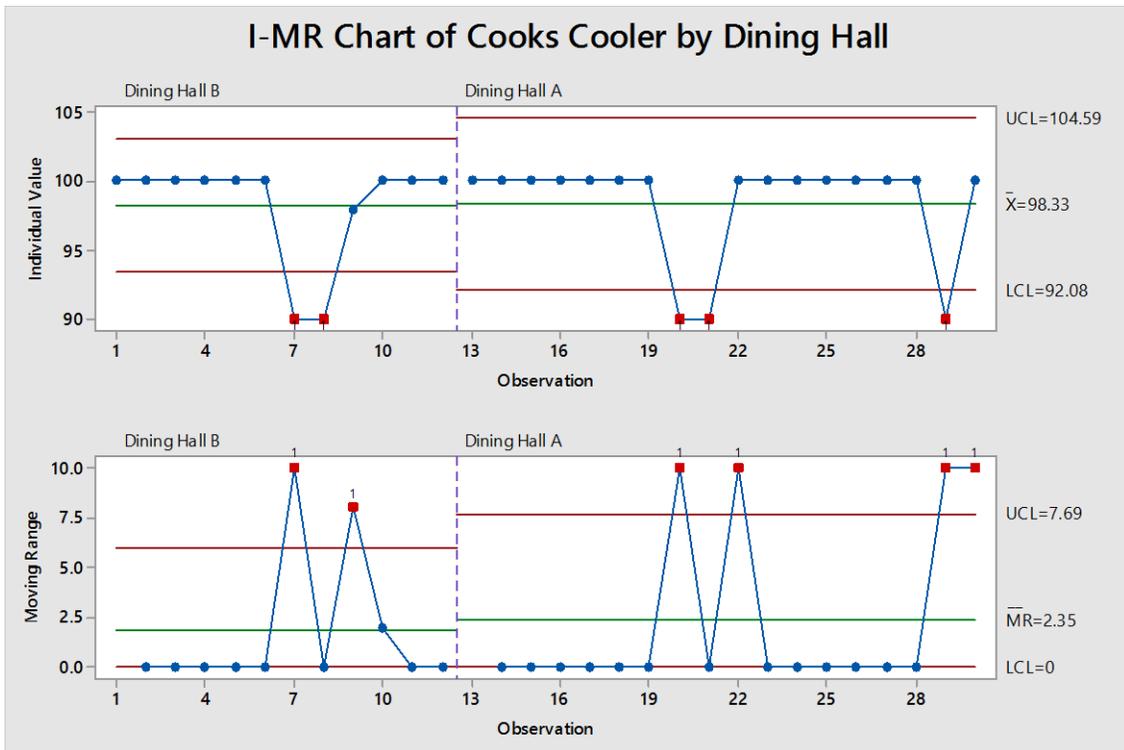
Dining Hall A - Concept Counter Cleanliness
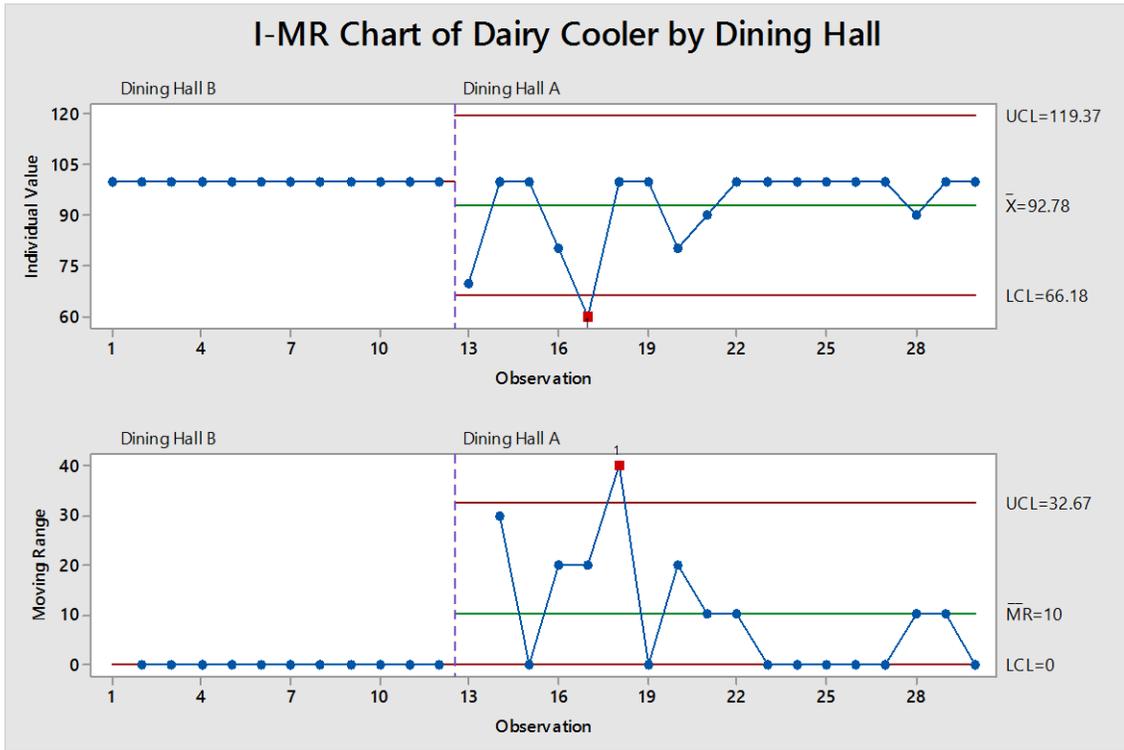

Dining Hall B - Concept PPE Accessibility
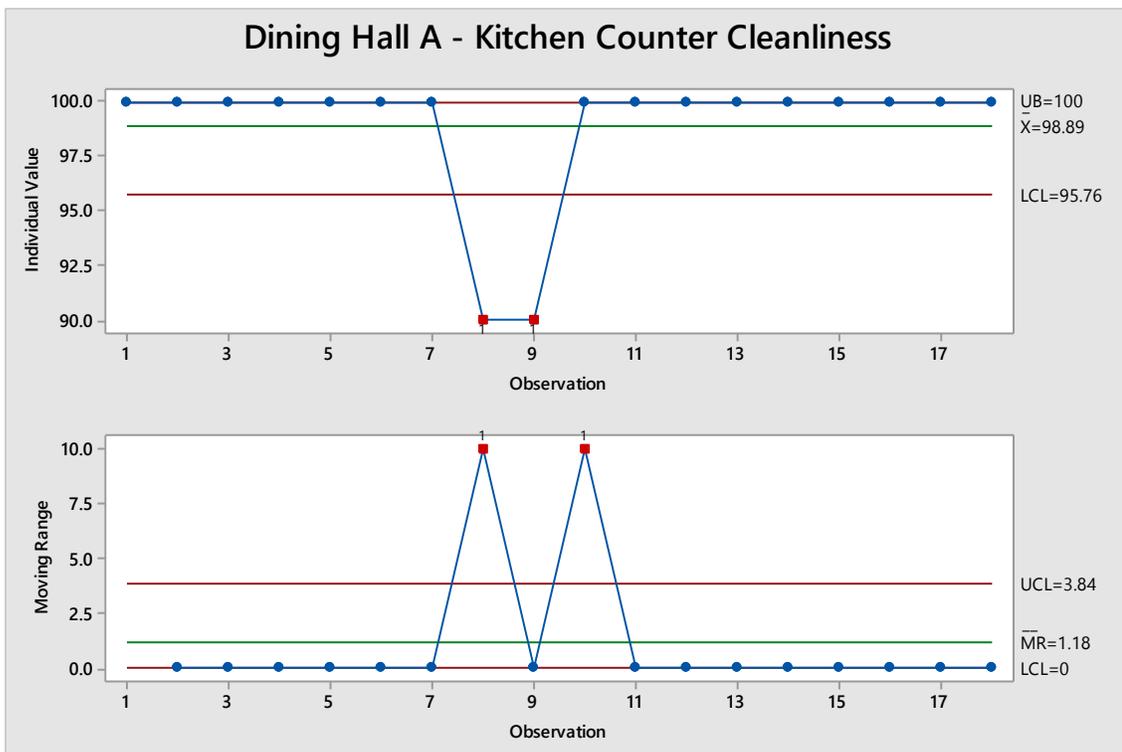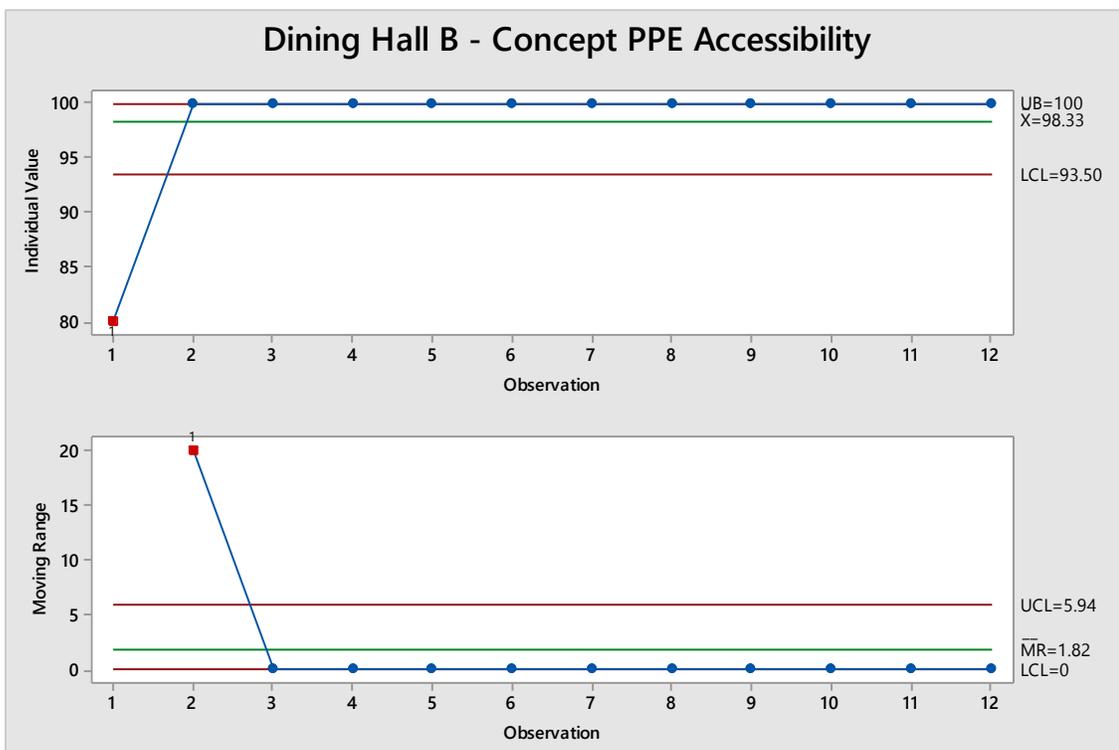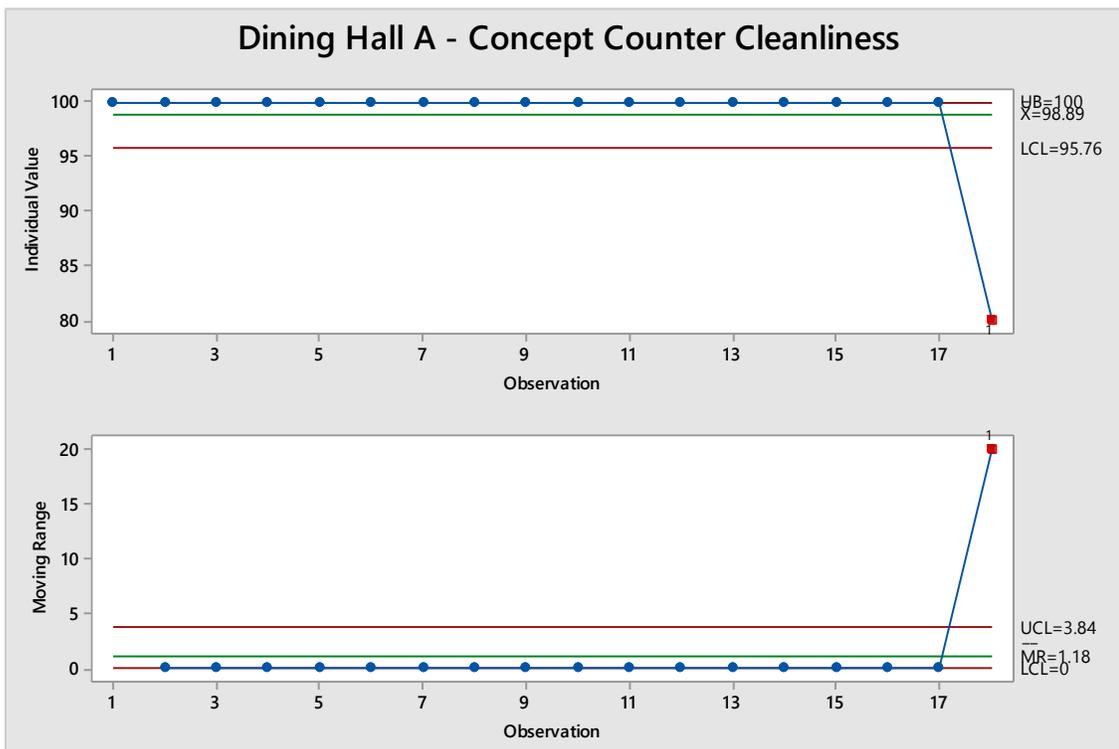
APPENDIX K: I-MR CONTROL CHARTS FOR DINING HALL A AND B

I-MR Chart of Storage by Dining Hall

I-MR Chart of Mop Room by Dining Hall

I-MR Chart of Freezer by Dining Hall

I-MR Chart of Kitchen by Dining Hall

I-MR Chart of Dairy Cooler by Dining Hall

I-MR Chart of Cooks Cooler by Dining Hall

I-MR Chart of Produce Cooler by Dining Hall

I-MR Chart of Dishwashing by Dining Hall

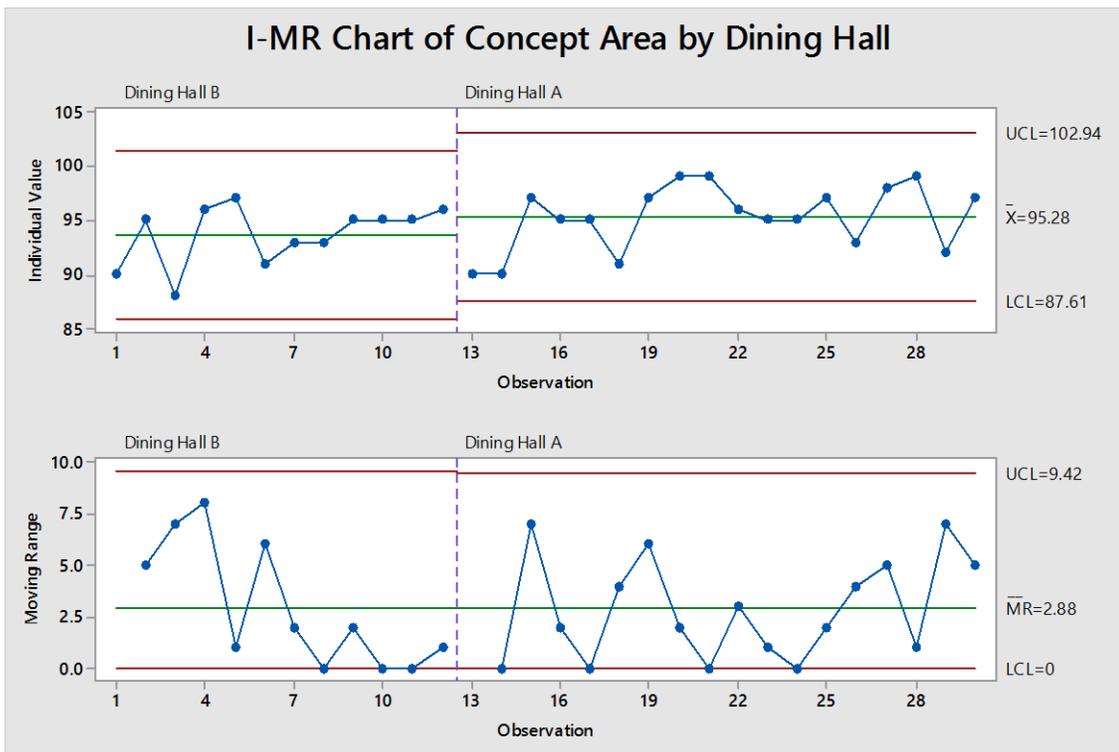I-MR Chart of Concept Area by Dining Hall
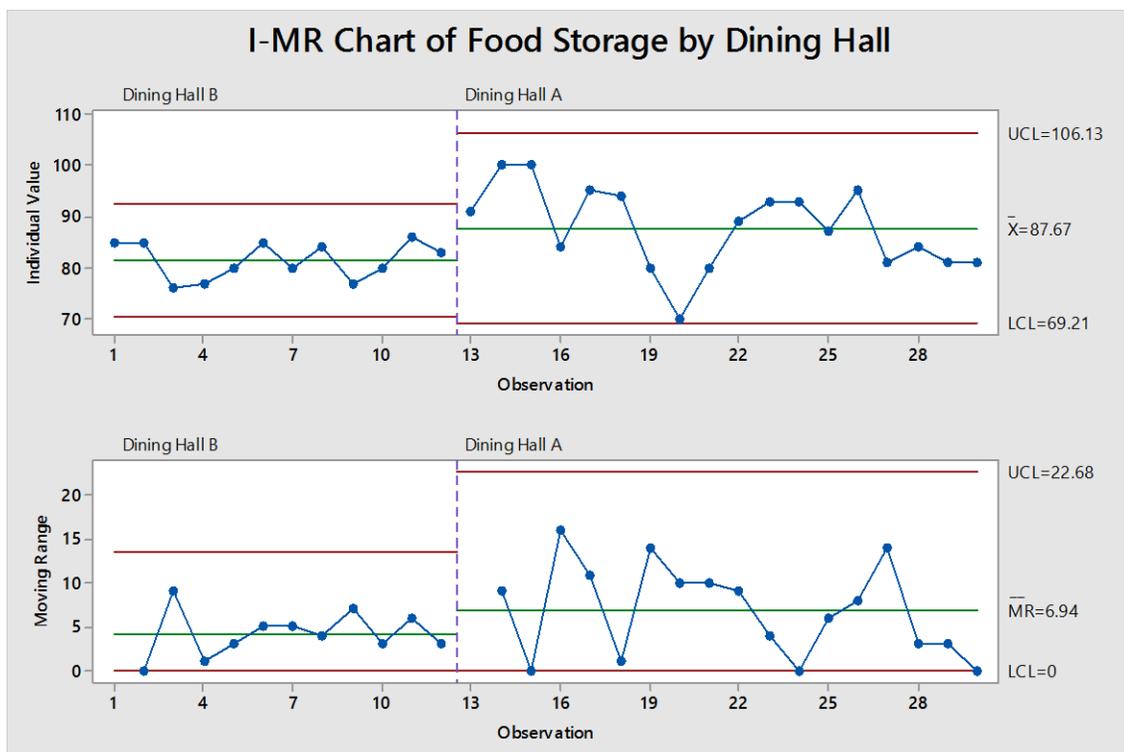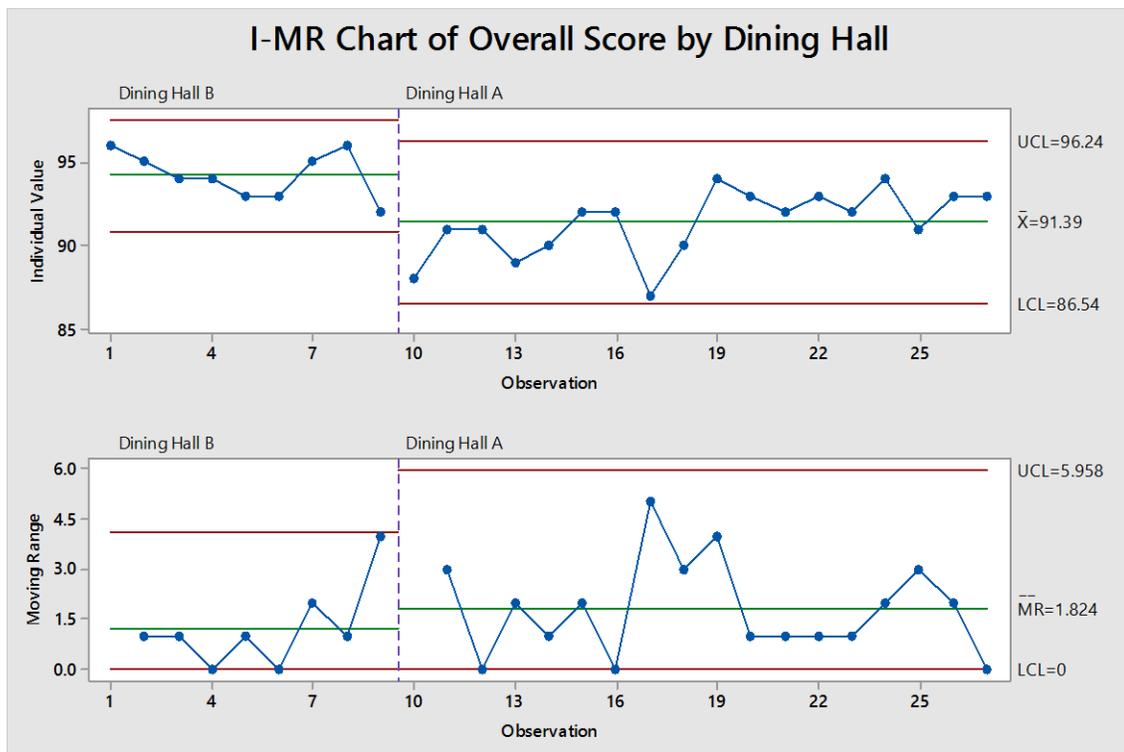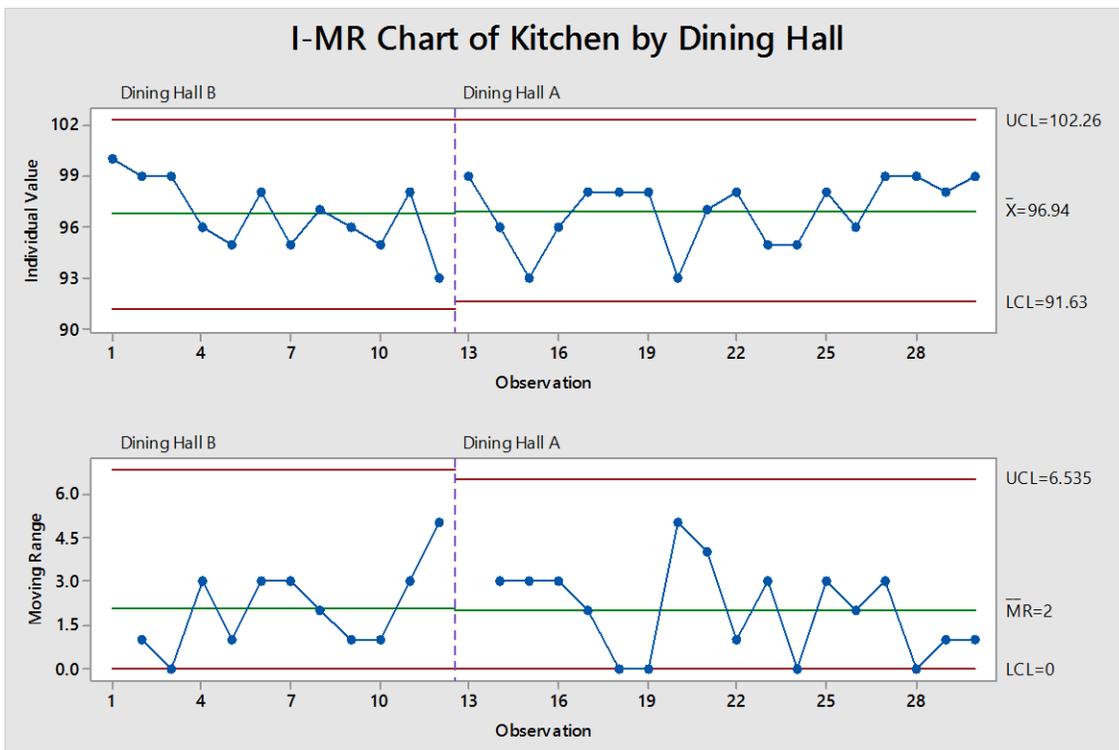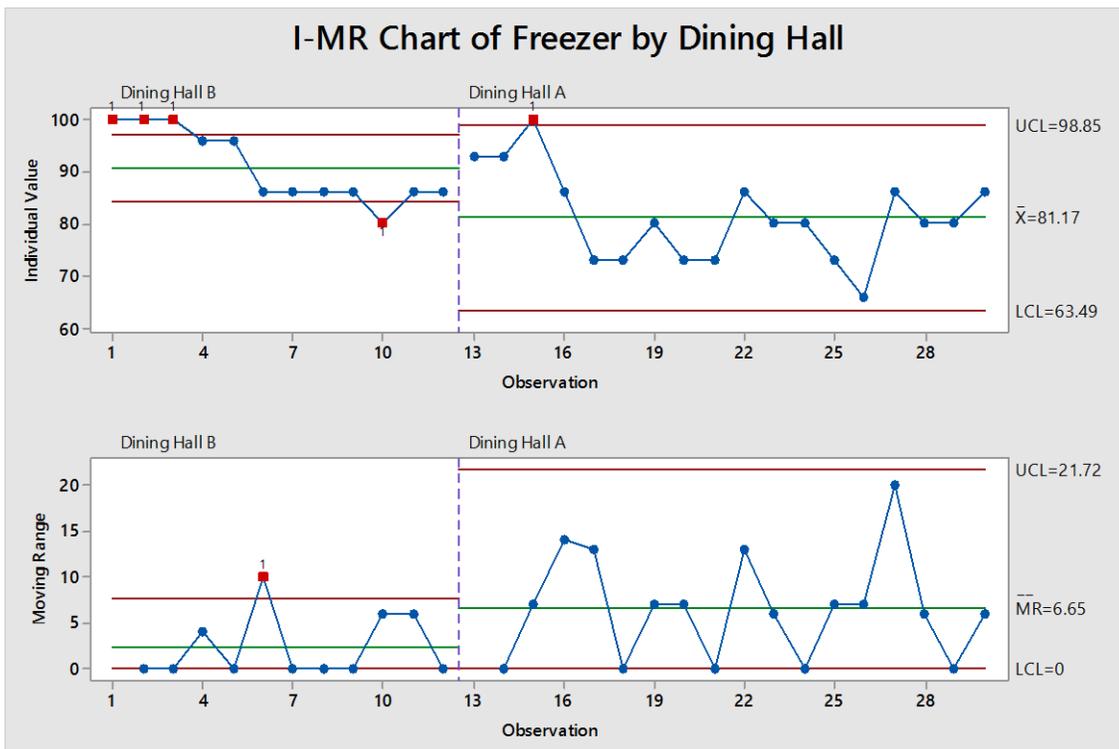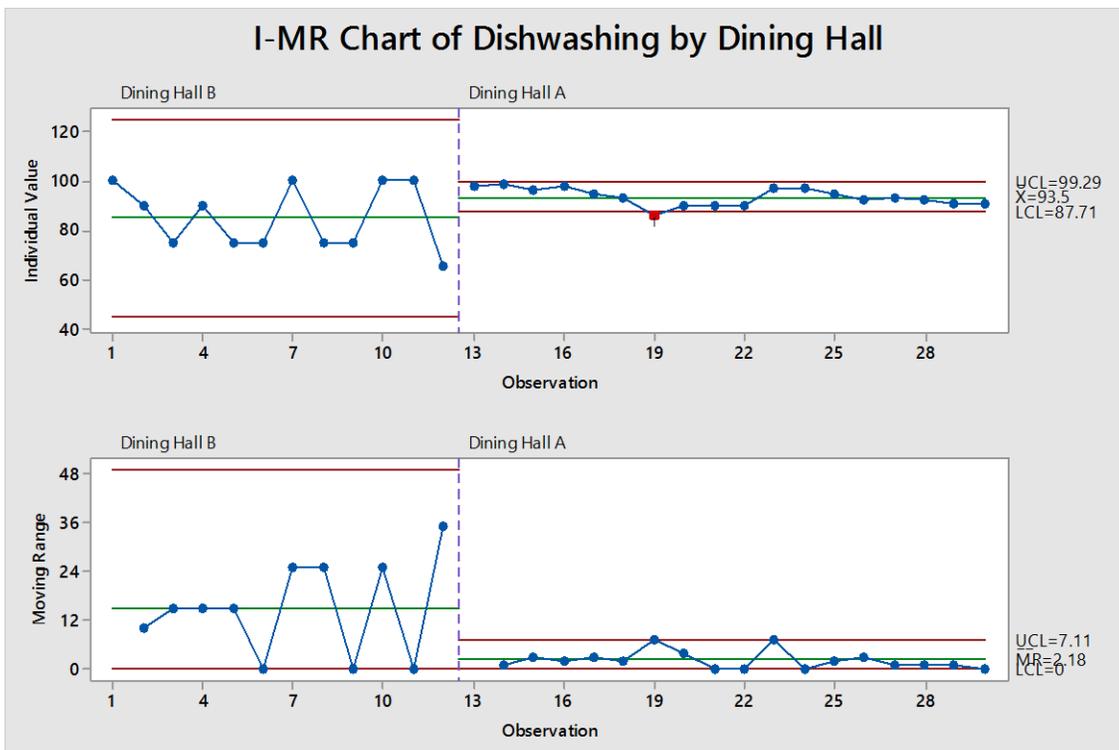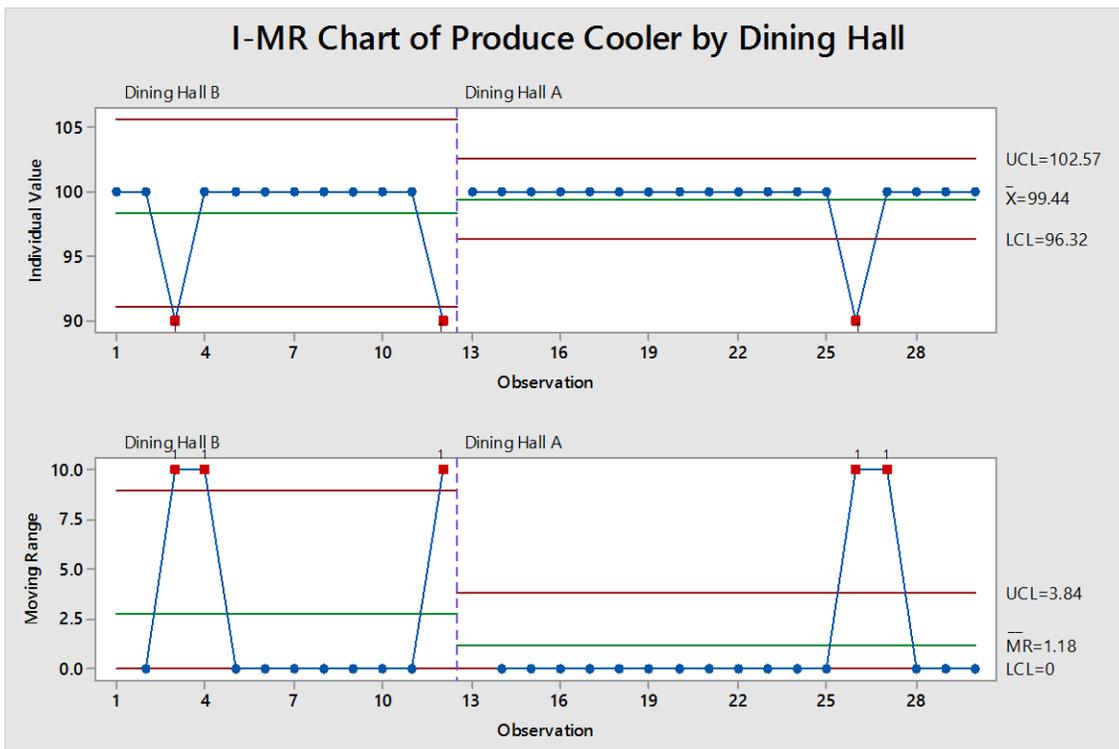
APPENDIX L: CONDENSED AUDIT REPORT EXAMPLE

Safety Audit Report

Audit Date & Time: 2/3/2015 @ 12:00 PM   Overall Audit Score : 94**%**

Items coded in **RED** have a score of 70% or below (equivalent is ≤ C on grading scale)

Area/Room	Score
Storage Area #1 (Food supplies)	80%
Storage Area #2 (Chemical/mop closet)	97%
Storage Area #3 (Washer/Dryer Room)	99%
Walk-in Freezer	86%
Walk-in Refrigerator #1 (Cheese Cooler)	100%
Walk-in Refrigerator #2 (Cooks Cooler)	90%
Walk-in Refrigerator #3 (Produce Cooler)	100%
Walk-in Refrigerator #4 (Dairy/milk)	100%
Walk-in Refrigerator #5 (Thawing room)	100%
Kitchen (Prep/cook area)	95%
Dishwashing Area	100%
Serving/Front End	93%

Immediate attention/Follow up items:

Item	Defect/Reason
Emergency Exit	Fan blocking doorway & running temporary cord through ceiling – written up 1/29 – cord fixed 2/2 Work order in for mounting fan 1/29

Lip in floor in washer/dryer room	Lip in floor presents in fall/trip hazard – Suggest having a yellow line painted on edge of level change – written up 2/2
Flooring lifted in Produce Cooler	Rivets in flooring are broken causing flooring to lift presenting trip hazards – written up 1/29
Flooring lifting in Cooks Cooler	Rivets in flooring are broken causing flooring to lift presenting trip hazards – written up 2/2
Lip in Floor in Washer/Dryer room	Presents trip/fall hazard – Suggest having a yellow line painted on lip of floor – written up 2/2

Other concerns:

N/A

APPENDIX M: EXPANDED AUDIT REPORT EXAMPLE

Safety Audit Report

Audit Date & Time: 2/3/2015 @ 12:00 PM   Overall Audit Score : 94**%**

Items coded in **RED** have a score of 70% or below (equivalent is $\leq$ C on grading

---

Storage Area #1 (Food supplies):   Total Score: 80%

Floor Cleanliness = 100%

Shelf storage ergonomics = 0%

2 pts/ instance	x	**5** **(# of instance)**	=	10/10 wrong	=	**0%** **(score)**

- Instances include heavy items on top shelves and stacking items too high
- Rice bags in box – heavy 25 lb bag stored in back of box, while lighter bags in front. Reach for heavier items is greater. A better design that would allow a close reach for both size bags would be better.

5 pts/ instance	x	**3** **(# of instances)**	=	15/100 wrong	=	**85%** **(score)**

Proximity of storage to ceiling (Fire Safety) **= 85%**

- storage that impinges on minimum required space of 18 inches from ceiling

Organization & Storage of materials/tools = 100%

- Materials/tools are very organized & can be easily accessed

Storage Area #2 (Chemical/mop room)   Total Score: 97%

Floor Cleanliness = 100%

Chemicals

1. **Chemical Labeling = 100%**

   - All chemicals were properly labeled and readable

2. **Aerosol Can Caps = 95%**

5 pts/		**1**		5/100		**95%**
instance	x	**(# of instances)**	=	wrong	=	**(score)**

   - One aerosol can was not capped

Storage Area #3 (Washer/Dryer Room   Total Score: 99%

Floor Cleanliness = 100%

Proximity of storage to ceiling (Fire Safety) **= 100%**

- storage that impinges on minimum required space of 18 inches from ceiling

Chemicals

3. **Chemical Labeling = 100%**

- All chemicals were properly labeled and readable

4. **Aerosol Can Caps = 100%**

- All aerosol cans were properly capped

Organization & Storage of materials/tools = 80%

- Materials/tools are disorganized, cluttered & present hazards

- Tools/supplies may be difficult to find or reach

Walk-in Freezer: Total Score: 86%

Floor Cleanliness = 100%

Ice build-up = 60%

- ice build-up is starting to accumulate on freezer floor

- Ice build-up is starting on ceiling

Shelf storage (ergonomics) = 100%

- Storage follows ergonomic guidelines (heavy items=waist level, lighter items=higher & lower shelves)

Kitchen (Prep/cook area):   Total Score: 95%

Floor Cleanliness = 80%

Counter/work area cleanliness = 100%

PPE

3. **Employees using proper PPE = 100%**

   - All employees were seen using PPE

4. **Placement/visibility of PPE = 100%**

   - PPE is visible & easily accessible

Organization & Storage of materials/tools = 100%

Chemicals

1. **Chemical Labeling = 100%**

   - All bottles & cans were clearly labeled

2. **Aerosol can caps = 90%**

5 pts/ instance	x	**2** (# of instances)	=	10/100 wrong	=	**90%** (score)

   - Two aerosol cans were not properly capped

Carbon Dioxide Tanks = 100%

   All tanks were capped & chained.

Walk-in Refrigerator #1 (Cheese Cooler):   Total Score: 100%

Floor Cleanliness = 100%

Shelf storage ergonomics = 100%

- Storage follows ergonomic guidelines (heavy items=waist level, lighter items=higher & lower shelves)

Walk-in Refrigerator #2 (Cooks Cooler):   Total Score: 90%

Floor Cleanliness = 100%

Shelf storage ergonomics = 80%

2 pts/ instance	x	**1** **(# of instances)**	=	2/10 wrong	=	**80%** **(score)**

- Storage follows ergonomic guidelines [heavier objects=waist level, lighter objects=lower or higher]
- Heavy cuts of meat stored on bottom shelves

   Notes:

- Rivets in floor are broken causing floor to lift and presenting a trip hazard

Walk-in Refrigerator #3 (Produce Cooler):   Total Score: 100%

Floor Cleanliness = 100%

Shelf storage ergonomics = 100%

Storage follows ergonomic guidelines [heavier objects=waist level, lighter objects=lower or higher]

Notes:

- Rivets in flooring are broken & flooring tiles are starting to lift – trip hazard & hazardous if cart wheels get caught up on them

Walk-in Refrigerator #4 (Milk Cooler)   Total Score: 100%

Floor Cleanliness = 100%

Shelf storage ergonomics = 100%

Storage follows ergonomic guidelines [heavier objects=waist level, lighter objects=lower or higher]

Walk-in Refrigerator #5 (Thawing Room)   Total Score: 100%

Floor Cleanliness = 100%

Shelf storage ergonomics = 100%

Storage follows ergonomic guidelines [heavier objects=waist level, lighter objects=lower or higher]

<u>Dishwasher Area:</u>   <u>Total Score: 100%</u>

Floor Cleanliness = 100%

Path of Egress (Y/N) = 100%

	Exit 1
Exit signs visible	Yes
Clear path to exit	Yes
score	10/10

<u>Serving/Front End:</u>   <u>Total Score: 93%</u>

Floor Cleanliness = 100%

Counter/work area cleanliness = 100%

PPE

1. **Employees using proper PPE = 100%**

   - All employees were seen using proper PPE

2. **Placement/visibility of PPE = 100%**

   - PPE is visible & easily accessible

Chemicals

3. **Chemical Labeling = 100%**

   - All bottles & cans were clearly labeled

4. **Aerosol can caps = 85%**

5 pts/ instance	x	**3** (# of instances)	=	15/100 wrong	=	**85%** (score)

   - Three aerosol cans were not properly capped

Immediate attention/Follow up items:

*Follow up item(s) status will be tracked

Item	Defect/Reason
Flooring lifted in Produce Cooler	Rivets in flooring are broken causing flooring to lift presenting trip hazards – written up 1/29
Flooring lifting in Cooks Cooler	Rivets in flooring are broken causing flooring to lift presenting trip hazards – written up 2/2
Lip in Floor in Washer/Dryer room	Presents trip/fall hazard – Suggest having a yellow line painted on lip of floor – written up 2/2
Emergency Exit	Fan blocking doorway & running temporary cord through ceiling – written up 1/29 – cord fixed 2/2 Work order in for mounting fan 1/29

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