# Improving Efficiencies for the Loading and Packaging Departments at San Luis Sourdough

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**by**
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ABSTRACT

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San Luis Sourdough, currently has issues with efficiency and standardization in their packaging department, ergonomics problems in the packaging department, shipment accuracy in their loading department, and lacks an organized layout design. As a result, four objectives were designed within a six month period. The first was to create standard operating procedures for the packaging department. To inform this decision time studies were performed before and after creating these SOPs. It was discovered that there was a clear need for the SOPs due to variation in packaging efficiency among new and experienced associates. The second set of time studies showed the SOPs were more effective than their current training program. The second was to reduce the ergonomic issues observed in the packaging department. During a visit to the facility, the number of times that an associate had to bend to reach a pallet, reach above for a pallet or utilize a ladder to reach a pallet was recorded. It was found that there were in fact ergonomic problems placing strains on the associates bodies and health. An optimal height was determined from observations, but the solution wasn't possible to implement due to it stemming from outside of San Luis Sourdough. The third was an implementation plan for a barcode scanning system within their loading zone. Data was collected on the number of loaves that they short their distributors and the money lost as a result. This data and a cost analysis did not support the decision to implement a barcode system that would in turn decrease the number of inaccurate shipments. However in order to save valuable time and stay up to date with technology in the manufacturing industry, it would be beneficial to consider implementing in the near future. The fourth was a new layout that designated a place for placing empty and full pallets, which are what hold the loaves of bread. The current layout was updated and redesigned into two new layouts. The Production Supervisor chose the superior layout based on its easy access for the packaging associates. He in turn said that it would be easy to implement if they decided to do so. Three of the four objectives were met and their results were as expected. The recommendations to San Luis Sourdough would be to implement the SOPs by training all associates to follow them, implementing a barcode scanning system in their loading zone, and redesigning the facility to match the improved layout.

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## I. Introduction

The problem statement for this project is that Bimbo Bakeries, also known as San Luis Sourdough, currently has issues with efficiency and standardization in their packaging department, ergonomics problems in the packaging department, shipment accuracy in their loading department, and lacks a clear layout design.

The first problem is that San Luis Sourdough currently has an efficiency issue within their packaging department. After the bread cools, the carts that are full of the finished bread loaves are placed at the of the packaging line. At which point, the feeder, the associate at the start of the packaging line, is responsible for placing these loaves on the conveyor belt to the next position, the slicer. The slicer then takes the of the conveyor and bags them in their respective packaging. The packaged loaves are then slid onto the conveyor belt to the trayer, the associate at the end of the line. The trayer places the packaged loaves into a basket, which is then sent on a conveyor belt to the loading zone. Throughout this process, there is a noticeable difference between the new and experienced employees, which causes the packaging lines to have varying output rates. These varying output rates cause the loading department to either be backed up or experiencing downtime. This is due to the way that the employees perform their assigned tasks. The more experienced employees have discovered the fastest ways to perform their tasks whether that is using one hand to handle the bread instead of two or preparing their station during downtime. This ultimately comes from a lack of standard operating procedures or training programs for this department. The first deliverable would be to implement standard operating procedures for the packaging line, which could be used to train new hires rather than just throwing them straight onto the line. By implementing a new standard procedure, the packaging department would be able to develop a standard packaging rate and create a standard that would decrease ergonomic issues, decrease their waste, and increase efficiency.

The second problem is that the packaging employees strain their bodies performing the tasks in the job lines. Upon visiting the factory, it was noted that the packagers move stacks of empty pallets into the packaging lines. This allows them to place the loaves that are done being packaged into these pallets, which are then placed on a conveyor belt that goes to the loading department. However, these stacks vary in height and can be as tall as ten feet, which requires some employees to step on a ladder to reach the empty pallets at the very top of the stack. The second deliverable would be to design an ergonomics approach to reaching the necessary empty pallets in the packaging department.

The third problem is the lack of shipment accuracy in the loading department. The loading employees who are working that shift receives the order quantity print out. The loader must manually calculate the number of stacks, 16 pallets each, that are needed to fulfill the order quantity. Also, they must calculate any partial stacks. These calculations are recorded on a piece of paper and are done utilizing a calculator. Once these calculations are completed, the stacks are

placed into the correct distributor zones' trucks. The loader manually records the number of pallets and the type of bread that was placed in the truck on a different sheet of paper, which is included in the shipment. Often, the distributors will contact San Luis Sourdough stating that the order they received was incorrect. The current procedure is that they must find the sheets that this data was recorded on and ask the loader that was responsible for that order to validate that the shipment was correct. These papers aren't enough proof to provide the distributors with. The third deliverable would be to create a system that allows the loaders to keep track of their shipments with greater accuracy and efficiency. This new system will provide the distributor with the necessary proof.

The fourth problem is the lack of a clear and accurate facility layout. Since the pallets are typically stacked sixteen pallets high, it makes visibility throughout the facility minimal. These pallets create a divide between the packaging and loading zones as well as making it hard for employees to maneuver throughout the factory. The fourth deliverable would be to design a new layout that designates, where to place the empty and full pallets. There are currently pallet racks in place along the walls of the facility but these are incorrect in the current facility layout. This will ultimately increase factory efficiency as well as decrease their number of lost loaves.

To meet these project deliverables, knowledge from various Industrial Engineering coursework will be utilized. Process Improvements, Human Factors Engineering, and Facilities Planning will assist with meeting these deliverables.

Objectives:

- An implementation of standardization and an increase in efficiency within the packaging zone
- A decrease in ergonomic issues in packaging zone
- An increase in shipping accuracy in the loading zone
- A clear layout design

## II. Background

The literature review will cover research related to efficient facility redesigns, barcode scanning methods vs. RFID in manufacturing, process improvement initiatives, lean methods, Kaizen, vision systems, and scheduling issues in the processing line. This research can be applied to this project by aiding in developing solutions to the previously mentioned problems as well as determining ways to test these new designs.

*Facility Layouts:*

Three different areas of facility layouts were researched in order to assist in the redesign of San Luis Sourdough. These consist of various methods that other successful companies

currently use, well known design aspects of the industry, and how to test the efficiency of each layout. “The design of a facility layout is the most important factor that determine the operational performance of a manufacturing system.”(Krishnan, 2009). This quote shows how important it is for a company to utilize an efficient facility layout. There are many different methods that can be used when creating a layout for a food manufacturing facility. The best method for a facility that needs a high level of flexibility due to complex systems would be using a mixed integer programming model based on a LP (Linear Programming) model (Azevedo, 2013). Another method that could be used to help the flow in the factory would be the SLP (Systematic Layout Planning) method. This method focuses on using logistical analysis to come up with functional zones (Wu, Hu, Wang, 2013; Yusof, 2015) within a specific area in order to arrange the position of related areas close together. This would result in minimized traveling distance and material handling. Using the SLP method would be the best fit for this project because the main goal of this layout redesign is to get the bread through the whole system as quickly as possible without it getting lost or stuck in the process.

The most import aspect of a facility layout is making sure that the bread can travel through the whole system in only a few days, so that the product stays fresh and does not get lost and need to be thrown out. The pace that the company can produce product and ship it out is very important in making a profitable company (Cormier, Kersey 1995; New, Wheatley 1996) especially in the baking industry. Safety issues are another important concept that must be considered in the final design. Some safety issues to consider are uneven floors and narrow aisles between machines or stations (Anonymous, 2015). San Luis Sourdough already has even floors but the aisle size will need to be taken into consideration to make it a safe environment for all employees. Currently there are no permanent aisles between the baking and packaging areas which is a safety hazard and will need to be improved.

In order to pick the best layout redesign all of the options will need to go through some testing and analysis. One option would be to use Little’s Law to calculate the time spent in the system (Ivanov, 2017) for both the loading and packaging areas of the facility. This will help determine which layouts are more efficient than others in getting bread out of the door quickly. Another option would be to create simulation models. One model would need to be created of the current process in order to have a better understanding and validation of the problem areas in the facility. New models would need to be created for each facility redesign in order to determine which layout gets the product through the system in the least amount of time (Chin, 2014). Both of these methods will be used to test all of the new factory redesigns to solidify which option is the best, but with emphasis on Little’s Law since the main goal is to decrease the time spent in the system.

*Barcode Systems vs RFID:*

Manufacturers face many issues with having large amounts of products and the logistics of these products. It has been found that RFID or barcode scanning methods can ease these

problems. Although implementing these methods can be costly at first, their costs are outweighed by the improvements in efficiency levels (Vereecke, Kalchschmidt, 2016). This will require an economic analysis of the costs associated with implementing a scanning method. RFID or barcodes can be applied to multiple aspects of the manufacturing industry: inventory control, distribution and supply chain management. Again, the costs are outweighed due to the reduction of inventory losses and the improvements of process efficiency (Nayak, Singh, Padhye, 2015). In addition, these improvements can be increased if these methods are integrated with an Enterprise Resource Plan(ERP) or a different IT infrastructure (Ivantysynova, 2008). The reason behind these improvements is that RFID or barcode scanners allows manufacturers to monitor their products in real-time. This ability to monitor in real-time increases their optimization levels (Ding).

RFID and barcode scanning methods have their own set of outcomes and limitations. When comparing the two it is sometimes hard to decipher which one is more effective for a business. RFID can be better than barcodes if there isn't a direct line of sight, which barcode scanners rely on. RFID also works better if there are a large number of stacked cases that would need to be scanned individually with barcode methods (Cronin, 2018). RFID within manufacturing organizations can increase efficiency. It can be utilized to keep track of the finished goods inventories, which lowers this type of waste or eliminates it entirely. A study was done to test this hypothesis of RFID having a positive impact on manufacturing organizations. The results proved that the hypothesis was true (Zelbst, 2018). However, barcode systems have since been applied to mobile applications. This mobile barcode scanning method is both cheap and effective in improving the warehouse. Mobile applications have revolutionized the system that has been in place for years. Mobile scanners allow the identifier to be sent to the database by simply taking a picture of a barcode. The flaws of this method is that it can only scan one entry at a time. Implementing this method can have a huge impact on a business and allow them to in turn save money (Pihir, Pihir, Vidacic, 2011). Both RFID and barcode scanning methods can have a positive impact in the manufacturing industry. The difference between the two is that RFID doesn't need direct line of sight and can scan multiple crates at once versus having to scan each crate individually with barcodes. Either of these methods could potentially assist the loading zone. San Luis Sourdough manually records the number of pallets and the types of bread included in each order. If one of these methods was implemented it would decrease the number of lost pallets, and increase their shipment accuracy with their distributors.

*Process Improvements:*

The packaging line will also need to be looked into to find other methods of revamping it. There are two alternative methods to picking or developing new methods for improvement: learn by doing on the shop floor, and learn by development and experimentation off the floor (Upton 1998.) This could be incredibly helpful in the project because it gives insight into two different

methods and that could be tried and then it could be seen whether learn by doing or learn by development would work better for San Luis Sourdough.

There are two types of learning, adaptive and generative learning. Adaptive learning merely responds to past errors by modifying future actions, while generative learning harnesses creativity to develop new knowledge and solutions to problems. These correspond with loop learning. There are four loops of learning: zero learning, single loop, double loop, and triple loop learning. Zero learning occurs when there is an issue in the line and there is nothing done about it. Single loop learning corresponds to adaptive learning in which if there is a problem, it is fixed at the time but there is no learning or knowledge gained by fixing the problem. This can cause the problem to occur again. Double loop learning corresponds to generative learning and involves questioning why a problem is occurring and changing the process to get rid of the root causes. Triple loop learning is the creation of new, innovative knowledge which might for example lead to a completely different process than the one that is being improved. This could mean questioning the relevance of the original process altogether (Grigg, Walls 2007). When improving San Luis Sourdough, the utilization of double or triple loop learning must be used to improve all of the processes because zero learning or single loop learning is currently being used.

*Lean Methods:*

The concepts involved in the combined Lean Six Sigma such as inadequate processing, defects, waiting, over production, and inventory are a great way to improve a process. This can be achieved by using Kanban, Just-In-Time (JIT), Standard Work, 5S, ect. (Aqlan 2018). One tool that would be useful for the project would be the Standard Work tool because it reduces variation and increases consistency. As of now, San Luis Sourdough does not have a standard way to perform each task in the packaging line and that is costing them valuable time.

Even though implementing lean may seem like a no brainer, sometimes it is hard to put into place because of resisting forces. There is a natural resistance to change seen as scepticism on the validity of the lean philosophy, assuming that lean is another improvement initiative fad that will fade away, or lack of availability of time where it is thought that there is no time to implement anything new (Melton 2005). Knowing about these push backs is vital so that when implementing lean in to the processes, there is an expectation of resistance and also a plan to deal with it.

Lean production adoption is considered to be an important method towards managing the operational and strategic gains for reducing waste. Early research within this area has suggested that to achieve and balance continued competitive advantage, organizations required the creation of better production systems to acquire higher product quality that reduces the product design and lead times, thus reducing the waste and overproduction levels (Satya, Ganji 2017). With San Luis Sourdough needing to reduce overproduction and waste, looking into these adoption methods would help greatly.

The desire is to find the best way to implement lean processes into the packaging and loading processes. In a company in the UK their method to implement was first, a lean team was formed with the people from different departments in the company, who were knowledgeable and experienced about the products, processes, equipment, and planning. Second, the lean team leader collected the production data and generated the process map by studying each stage of the manufacturing processes with the help from the team members. Finally, strategic areas for implementing lean tools were identified based on the data and observation (Kennedy, Plunkett, Haider 2013). A company in Chile took the approach to first, make detailed analysis on each of the workstations, evaluating organization of equipment and which tools and documents were needed to perform most common operations. Second, after the analysis on the current status of the shop floor, an evaluation checklist was produced for each workstation with the main issues requiring addressing in each of the 5S steps. Finally, corrective measures were implemented, consisting in tidying up, organizing, cleaning, normalizing and establishing control measures in workstations (Borges Lopes, Rui, Freitas, & Sousa 2015). Seeing how it was implemented at a few different companies is incredibly helpful for the future implementation.

*Kaizen:*

There are also many obstacles with adopting lean manufacturing in food processors including lack of a clear vision of the future and of what is possible to be achieved and failure to see that management must use lean methods to change the culture. There are two levels of involvement in Kaizen practices 5S also called workplace organization, or a kaizen event also called a blitz. The process involves doing a series of focused improvement sessions, usually three to five days, on a work process. Each time a session is held, a different improvement approach will be adopted, depending on the constraint or need. The employees learn lean practices as they are implementing them (Heymans). These are all valuable insights to use, especially getting all of the workers involved in the kaizen practices, as there is a need to create a standard practice for the packaging process and all of the workers have their own methods of packaging.

*Vision Systems:*

There is a new approach to checking quality on the line, using a machine vision system. The goal of machine vision is to electronically achieve visual perception. In order to do so, a vision system relies on electronic processors to acquire and analyze images seen through an imaging device such as a solid-state camera. Light passes through the camera lens and the image is broken down into individual picture elements called "pixels." Each pixel has an analog voltage level that represents its light intensity. A computer converts the analog voltage values for the entire image into their corresponding digital values. The result is a digital pixel array that can be analyzed and interpreted by a computer. There are two broad areas in which vision systems are generally used in manufacturing processes: the visual control of robotic assembly and automatic visual inspection (Hormozi 1992). The second area, automatic visual inspection, could be a great

idea to implement into the packaging line to check for issues and keep track of what product is going by and how many.

*Variability in the Processing Line:*

Because there are so many different types of bread being made it is difficult for the packaging line to stay consistent. Because each type of bread is different in size, shape and texture, they need to be handled differently in the bagging process. Because of the combinatorial complexity of the bread production process, efficient solution methods have not been carried out. It is said that the labor productivity is absolutely lower than any other food processing industry. The minimization of the maximum completion time (make span) is the most important factor to reduce the uselessness of production. By aiming this, high-mix low-volume production is carried out. To reduce the opportunity loss, the maximization of the minimum amounts of products is necessary. At first, one should examine the minimization of the maximum completion time. The mass production is achieved by using newly appeared free-time of the production line. (Matsumoto, Shimpei, Koji, and Hiroaki). Having the cooling bread laid out by size and shape would decrease the variability and thus decrease the change over time on the line.

## III. Design

As previously mentioned, San Luis Sourdough currently has issues with efficiency and overproduction in their packaging department, ergonomics problems in the packaging department, shipment accuracy in their loading department, and a lack of a clear layout design. After visiting the facility multiple times and conducting a literature review, some potential design solutions to these issues were devised.

The first problem is that San Luis Sourdough has issues with efficiency in the packaging department. On our first initial visit it was noted that due to a lack of a standard packaging rate, the packaging department can send an excess of packaged loaves to the loading zone. Since the loading zone is manned by two personnel, this leads to their workspace becoming cluttered with pallets of packaged loaves, which in turn causes there to be an increase in waste. This waste results from packaged loaves becoming lost in the clutter of pallets. In addition, one of the team leads on the line said this problem stems from a lack of standard operating procedures and proper training. After talking to the team lead and taking notes on the issues that he has seen on the line, the team decided to watch the packaging line. Upon observing the packaging line at a peak time, it was noted that each worker in the line operates at a different standard. Some employees work at a fast pace using only one of their hands to quickly slide the bread in the bag, while others work at a slow pace needing both of their hands to keep the bread from falling apart while

packaging the loaves. In order for the team to be able to make changes there was a comparison between a group of veterans on the line who had been there for years vs a group of newer hires

Figure 1: Veteran vs. New Associates Time Studies

| Average Times (Seconds) | | | |
|---|---|---|---|
| Positions | Veteran | Newer | % Difference |
| Feeder | 1.29 | 1.74 | 29.7% |
| Slicer | 61.43 | 83.7 | 30.7% |
| Trayer | 6.56 | 7.16 | 8.7% |
| Total | 69.28 | 92.60 | 69.14% |

who have been there for a couple months. Each position was timed 10 times to see how long the operator took to do the job(See Figure 1). It was found that the average time for the feeder position for the veterans was 1.29 seconds while the newer hire average was 1.74 seconds. It was then found that the average time for the slicer position for the veterans was 61.43 seconds while the newer hire average was 83.70 seconds. Finally it was found that the average time for the trayer position for the veterans was 6.56 seconds while the newer hire average was 7.16 seconds. After taking the average of the overall veteran line and the newer hire line it was found that it took the newer hires 23.33 more seconds on average to package one loaf of bread.Because of this it was deemed important to watch the way in which the veterans packaged. After watching the veterans, the team was able to see that they had better methods for completing their tasks than the newer hires did. After taking notes on how the veterans performed their procedures, the team was able to come up with a set of Standard Operating Procedures (see Appendix F) depending on the type of bread that is getting packaged. Kaizen research and practices will allow for a successful implementation of a training program for their packaging department and will allow for it to keep changing if a better, faster method is found.

The second problem is that there are ergonomic issues within the packaging department. Upon visiting the factory, it was noted that packaging employees place a great deal of strain on their bodies while performing their necessary job tasks. The employees of smaller stature must reach above their heads to bring the pallets down from the top of the stack while standing on a ladder. They need these empty pallets to place the packaged loaves in at the end of the line before sending them on a conveyor belt over to loading. This is both time-consuming and dangerous for the employees. Within a thirty minute time period, every motion that could cause ergonomic issues was recorded(See Figure 2).

Figure 2: Ergonomics on Two Packaging Lines

| | Reach for Pallet | Ladder to Pallet | Bend Over |
|---|---|---|---|
| | 11:42 | 11:46 | 11:54 |
| | 11:43 | 11:46 | 12:02 |
| | 11:55 | 11:58 | 12:02 |
| | 11:56 | | 12:03 |
| | 12:03 | | 12:03 |
| | 12:03 | | 12:08 |
| | 12:03 | | 12:09 |
| | 12:04 | | 12:09 |
| | 12:05 | | 12:09 |
| | 12:10 | | 12:09 |
| | 12:10 | | 12:10 |
| **Total** | **11** | **3** | **11** |

The time was recorded every time a packaging associate performed one of these three tasks: reaching for a pallet, stepping on a ladder to get a pallet, and bending over. It was discovered that on the two lines the packaging associates reached for a pallet 11 times, stepped on a ladder to recover a pallet 3 times and bent over to get a pallet 11 times. A solution could be created by determining the optimal height to have the pallets stacked at.

The third problem is that their shipments lack accuracy in the loading department. Upon talking to the supervisor, Jaime, he explained that their distributors utilize a barcode scanning method. They print and place a barcode on each stack of pallets to keep a record of the quantities and types of bread that they are receiving in each load. Their distributors then inform them that the

Figure 3: Shipment Check Sheet


Product/Depot Double Check Sheets — TRADER JOE'S

Delivery Date:_____

Zone #_____

Intial

| Product name | # Baskets | Product name | # Baskets | Product name | # Baskets | |
|---|---|---|---|---|---|---|
| 40 | | 41 | | 42 | | |
| 43 | | 44 | | 45 | | |
| 46 | | 47 | | 48 | | |
| 49 | | 50 | | 51 | | |
| 52 | | 53 | | 54 | | |
| 55 | | 56 | | 57 | | |
| 58 | | 59 | | 60 | | |

| PRODUCT NUMBER | PRODUCT NAME | PRODUCT TRAY TOTALS | Intial |
|---|---|---|---|
| 7474 | CRACKED WHEAT-SL | | |

shipments they received are inaccurate, which causes a discussion to take place for a few days to decipher what went wrong and where the missing loaves are. The San Luis Sourdough management informed the project team that this happens everyday. Upon hearing this, it was decided that the next step should be to observe the loading zone and speak with the team lead. There are two associates within the loading zone at all times. Once they receive

the order, they take a calculator and manually calculate the number of full and partial stacks of loaves. A full stack is 16 baskets and a partial stack varies. They record this number on a piece of paper at which point they move the stacks into their respective zones.

Once the truck is full, they record on another piece of paper the number of baskets and the types of bread that were included in that order(See Figure 3). The team lead mentioned that this process is rather time consuming and can lead to many errors. After researching about RFID and barcode scanners, it was discovered that implementing a barcode scanning method, which is cheaper than RFID, could increase their shipment accuracy and decrease their finished goods waste(Zelbst, 2018). To inform this decision, data was obtained from the sales department on the actual numbers for shipment inaccuracy and the cost associated with these errors within the past three months. This three month time period was chosen due to implementation standards within the manufacturing industry. In the past three months, San Luis Sourdough shorted their distributors by 44 loaves. Jaime mentioned that each loaf costs approximately 80 cents to make. Focusing on the cost of goods sold alone, this means that they lost $35.20 within the three month span. More research was performed to examine what other companies in the manufacturing industry have previously implemented. As a result, an implementation plan was devised based on industry standards.

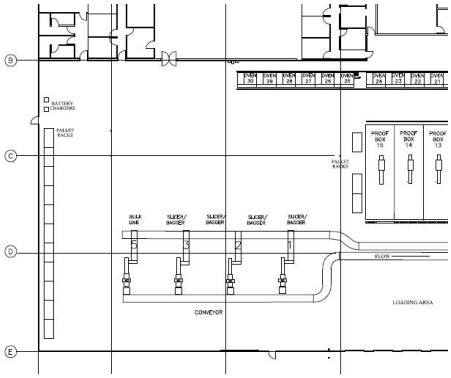
- The first step is to define the goal, which is to decrease the number of inaccurate shipments.
- The second step is to assess the area of the business that will be affected by the barcode system, which is the loading zone.
- The third step is to ensure that it integrates with any existing systems, which are internal systems.
- The fourth step is to record data on the number of inaccurate shipments for three month period before implementation.
- The fifth step is to explore equipment and materials options. It must be decided if wireless scanners or wired will be better for the zone. In addition, they must decide if they would like to print or purchase barcode labels. They also will have to decide what kind of barcode labels they would like as some are more durable than others. In order to ease the decision process, an analysis will be performed of what the top manufacturing barcode companies currently offer.
- The sixth step is to implement the barcodes in one pilot area, which will be the loading zone. Data must be collected on the number of inaccurate shipments for a three month period after the barcodes are implemented. The performance of the pilot program can be analyzed and evaluated by comparing their accuracy for the three month period before with the three months after implementation.
- The seventh step is to ensure that the team buys into the implementation process as the success of it will be determined by their ability to adopt the new process. The eighth step

is to enlist an expert to ensure a smooth and successful barcode implementation, which could be a Bimbo Bakeries IT professional.

This implementation plan will make the transition as smooth as possible(Guo 2015). Overall, this design solution could aid San Luis Sourdough by increasing their shipment accuracy in the loading department therefore increasing their profit.

The fourth problem is that San Luis Sourdough lacks a clear and complete layout design, which can lead to a high level of waste due to lost products. A current layout of the facility was obtained to observe the current state, which can be seen in Appendix A. The main area of the layout that will be corrected and improved can be seen in Figure 4. This is the packaging area. The four lines shown to the bottom of the diagram represents the four packaging lines attached by a conveyor belt. The pallet racks shown in this figure are not shown in their true locations, against the far left wall in Figure 2. This layout also does not include where the empty pallets should be located, which is then left open for interpretation by the associates. The current layout also lacks a specified area where the bread should be cooled. Recently Jaime, the Production Supervisor, implemented a system for specifying where breads should be cooled based on their type. This system was put into place in order to help the packaging associates with finding the type of bread that they need to package to fulfill the orders. These designated areas will need to be added to the new layout design since it is currently not apart of the layout.

Figure 4: Current Facility Layout




When the open area in the middle of the figure isn't full of bread that is being cooled, it is also occupied by the empty pallets, which makes it difficult to decipher which are full of bread or empty. This, in turn, contributes to the problem of misplaced or lost goods. San Luis Sourdough needs a specified area where these empty stacks can be stored so that employees can have increased visibility and maneuver efficiently and safely throughout the facility. Once all of these aspects are added to the new layout, a pathway between each station will need to be shown so that the employees can maneuver around the facility with ease. This pathway would need to be taped off on the floor so that it will always be known that the aisle should remain empty. The first step in actually establishing the new facility redesign is to create the current state layout using Visio (Currently it is a PDF and the AutoCad file has been lost by San Luis Sourdough). This is important because all of the measurements of the building and permanent features need to be accurate and included on the new model. The redesigned layout will need to include the areas where different types of breads should be cooled as well as where the empty trays and pallets will be stored. The locations of the existing pallet racks will be updated and moved as necessary. Once this is completed the draft of the new layout will be created also using Visio.

## IV. Methodology

The first design solution is to implement Standard Operating Procedures (SOPs) within the packaging zone to increase their efficiency. In order to test the SOPs, they will be tested on office workers. Since the workers in the office have not performed any of the job duties on the packaging lines, this is comparable to a new-hire. One will be given the SOPs to read before performing each position, while the other will be trained by one of the team leads on the line. They will then be placed in one of the three positions: feeder, slicer, and trayer. Time studies will be performed ten times for each position, as this was what was done for the initial time studies. The averages will then be computed to compare the two office workers to each other and with the previous time studies of the newer packaging employee (See Figure 1). This will establish whether the standard operational procedures had an effect on the efficiency of the packaging lines.

The second design solution is to implement an ergonomic system for the packaging zone to allow them to easily reach for the pallets. In the same thirty minute study done previously(See Figure 1), four different packaging baggers, two women of stature 5’ 4” and two men of stature 6’ 0”, were observed. From these observations it was noted that the optimal pallet height was four pallets to prevent bending over and ten pallets to prevent reaching too high. If these optimal heights are maintained then the baggers would not have to bend over or reach high frequently, which in turn can cause damage to their health and bodies.

The third design solution is to implement a barcode system within the loading zone to increase their shipment accuracy. As a result, an implementation plan was devised for barcode scanning methods. In order to successfully test if the implementation plan is correct two comparisons will be done. The first is to perform a competitor analysis of the top manufacturing barcode companies. They will be compared in terms of their integration with existing technology, durability of barcodes and scanners, offerings and price. The second is to perform a cost analysis study. This will compare the number of inaccurate shipments and their costs with the estimated costs for implementing a barcode system. In addition, this will allow for a return on investment to be calculated. This assists with deciding if implementing a barcode system will benefit San Luis Sourdough financially. Both of these comparisons will test whether the implementation plan for a new barcode system will be financially feasible and if it is which option will best fit their needs.

The fourth design solution is to implement a new facility layout at San Luis Sourdough. In order to test the facility layout designs, two layouts were created. These layouts are shown below in Figure 3. The only area within our scope for this project was in the packaging area, so the layout redesign was created in this area only. The rectangles along the walls represent pallet racks and the colored squares in the middle represent the different types of bread that will be

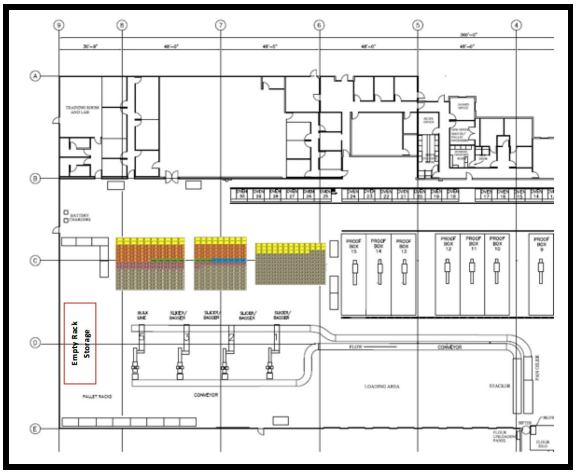
stored there. Each color represents a different type of bread. For example the green boxes represent the “stubby” loaves. The top part of the diagram represents the office space, and nothing was changed in that area. After these layouts were created, a set of criteria was developed in order to decipher which layout is optimal for San Luis Sourdough. Jaime, the Production Supervisor, rated both layouts on a scale from one to ten for each of the criteria with ten being the best and one being the worst.

The four criteria that were created are:

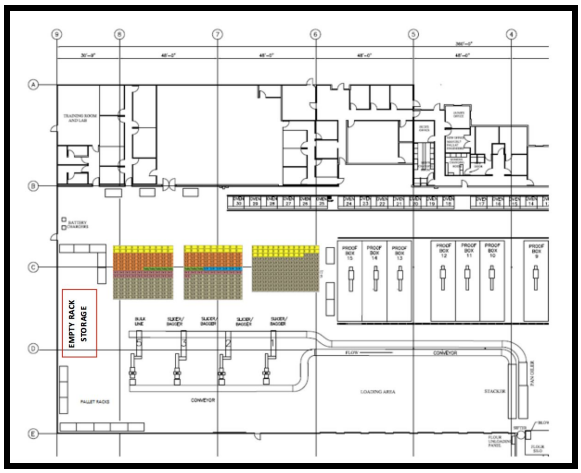
- the ease to implement
- allows for easy access to pallets for equipment to take/ put pallets away
- ability to safely maneuver facility
- location of the pallet racks.

Based on these criteria, it was decided that Layout 2 was the superior layout. The exact scored of these criteria for each layout are shown in Appendix G. The production manager also mentioned that he preferred Layout 2. The only way to actually test the chosen layout would be to physically implement it. In order to do this the new areas need to be taped off in the actual facility. The permanent aisles in the facility should also be taped off to ensure that they do not get filled with carts full of bread. The amount of bread lost in these areas would then need to be recorded to ensure the waste has decreased due to the new layout design.

Figure 5: Revised Facility Layouts




LAYOUT 1




LAYOUT 2

## V. Results

After testing the Standard Operating Procedures with the two office employees, the office employee that was given the SOPs performed better in all three positions as expected. However, for the feeder and trayer positions the difference was only marginally better as the positions are self explanatory. As for the slicer position, which is the bottleneck of the line, there was a substantial difference in terms of both the average number of loaves that were bagged and the learning time. It was discovered that even with the SOPs, the slicer required the assistance of an experienced team lead packaging associate in order to fully understand the flow of bagging each loaf. The team lead packaging associate assisted both office employees for the slicing position and this learning curve was then timed. The employee that was given the SOPs beforehand took only 2 minutes to understand the position, while the worker without the SOPs took over 5 minutes to learn the position. The average time from the slicer to the bagging clip was 188.50

Figure 6: Office Employees with and without SOPs Time Studies

| | Average Times (Seconds) | | | Percent Difference | |
|---|---|---|---|---|---|
| Positions | Office w/ SOP | Office w/o SOP | Newer Line Employee | % Diff w/ SOP | % Diff w/o SOP |
| Feeder | 1.60 | 1.81 | 1.742 | -8.88% | 3.76% |
| Slicer | 188.50 | 216.26 | 83.7 | 55.60% | 61.30% |
| Trayer | 6.60 | 7.75 | 7.155 | -8.43% | 7.64% |
| Total | 196.70 | 225.82 | 92.60 | 38.30% | 72.70% |

seconds for the worker with SOPs, while the worker without SOPs average time was almost 30 seconds longer at 216.26 seconds(See Figure 6). The percent differences seen here are the averages of the office employees both with and without SOPs compared to the averages of the newer associate. The negative values show improvement on the time of the newer associate, while the positive values represent averages larger than the averages of the newer associate. For both the feeder and trayer positions, the employee with the SOPs was able to improve upon the time of the newer associate. For the slicer position though, the difference was was large, but that was foreseen because of the practice needed for that position. More data could have been acquired if there was more packaging lines to test this on so that there were more than two office employees. This extra data would provide a more accurate estimate on how much time the SOPs were able to save the associates. Because it was discovered that the SOPs didn't provide enough of an explanation for the slicer position, it would be beneficial to the associates to have them watch a training video as well. This training video could successfully outline the technique used to keep the bread from separating once in the bag and how to move the packaged loaf onto the conveyor belt towards the clipper. The social impact for implementing the SOPs would be that the veteran employees may not be entirely willing to conform to the new standard methods. Some of the more experienced associates have been working there for over 10 years and are set in their procedures. For the future, following the implementation of the SOPs and the video there

would be hours saved for training the new hires as well as establishing a standard throughout all of the employees. This in turn would assist with their quick employee turnover rate as a result of a lack of training.

Upon talking to the supervisor, it was noted that the empty pallets come pre-stacked from their distributors in a variety of heights. These results were unexpected as it was believed to be a simple process to stack these empty pallets at the optimal height of ten. Since devising a solution was out of scope for the project, it is suggested to San Luis Sourdough to look into this in the future.

A competitor analysis was performed to analyze a few of the top barcode scanning companies designed for the manufacturing industry(See Figure 7).

Figure 7: Competitor Analysis for Barcode Companies

| Company | Zebra | Dynamic Systems Inc | Intellitech |
|---|---|---|---|
| Integration | Yes | No | No |
| Durability | Yes | Yes | Yes |
| Offerings | Barcode Scanners, Printers, Labels, Software | Barcode Scanners, Printers, Labels, Software | Labels, Printers, Label Design Software |
| Price | Printers range from $100-$6000 | Sell other companies printers | Unknown |
| Services | Support, Knowledge Base | None | Knowledge Base |

After analyzing three companies: Zebra, Dynamic Systems Inc and Intellitech, it was discovered that Zebra would provide the best solution as they provide a fully integrated, durable system at an affordable price range. In addition, they offer an extensive knowledge base and support post-purchase, which will assist with the ease of implementation.

A cost analysis was performed to analyze the amount of money lost by San Luis Sourdough as a result of inaccurate shipments. Jaime provided the team with data on the number of loaves they shorted their distributors over three months, which was 44 loaves. Since the selling price for a loaf of their bread is approximately $2, it was found that they are losing a total of $52.80 in a three month span(See Figure 8). This was determined as they sell their loaves to Costco or Trader Joe's at a lesser value than Costco or Trader Joes' sells it for. The profit margin on a loaf is roughly $1.20. In the competitor analysis, Zebra was chosen as the best solution for their needs. A rough estimate of the cost to implement an industrial, rugged Zebra solution, which includes barcode printer, labels, software and scanner, is $1,733. This equates to the payback period being approximately 8 years from the purchase date, which is a high payback period. In addition, the ROI was found to be 4%, which means that this investment would not be

effectively utilized. In calculating the ROI, it was assumed that this technology would last them 10 periods or years before becoming out of date or run down.

Figure 8: Cost Analysis/ROI

| | | |
|---|---|---|
| Bread COGS | $ | 0.80 |
| Bread Selling Price approx. | $ | 2.00 |
| Profit | $ | 1.20 |
| | | |
| Total Amount Lost (3 Months) | $ | 52.80 |
| Total Amount Lost per month | $ | 17.60 |
| | | |
| Costs To Implement Zebra | | |
| Printer (ZT200 Series Industrial) | $ | 820.00 |
| 1000 Labels | $ | 68.00 |
| Barcode Scanner(LS3408-ER Rugged) | $ | 500.00 |
| ZebraDesigner Pro | $ | 345.00 |
| Total Cost | $ | 1,733.00 |
| | | |
| Payback Period | Approximately 8 years | |
| ROI | | 4% |

Both of these numbers were not as expected as the managers and team leads explained that the number of inaccurate shipments occurred almost every day. Upon determining these numbers, the number of shorted loaves was further analyzed. If you examine one zone's shipment assuming that it is completely full, this means that they would be shipping over 7,000 loaves of bread. Shorting their distributors 44 loaves in a three month time period is fairly low when comparing it to the number of loaves that they ship in one zone's shipment. The data determined that San Luis Sourdough doesn't lose enough money by shorting their distributors on their shipments to financially support the decision to implement barcode scanning. If you consider the hours wasted by manually recording their shipments or the days spent trying to decipher what went wrong with that shipment, barcode scanning would help them save valuable time. Every Bimbo Bakeries facility utilizes barcode scanning systems. San Luis Sourdough will need to implement this technology to compete with the rest of the manufacturing industry as paper methods are extremely outdated. Although implementing these methods are costly at first, their costs are outweighed by the improvements in efficiency levels (Vereecke, Kalchschmidt, 2016). Since the data shows that it isn't financially optimal to implement, there could be problems with persuading upper management of the need to implement a solution now.

Layout Option 2 was chosen due to its close location to the packaging line and ease to implement. It also allowed ease of access for those associates.These results were not surprising

since this was a very important aspect to picking the best design. If this layout is actually implemented at San Luis Sourdough, it is predicted that the amount of bread that is misplaced would decrease. There would be a clear area for the empty racks to be stored so that this area stays organized. This layout would also help the packaging area because they could see exactly where each type of bread is being cooled and stored so they know where to pull the bread from. This will decrease the time that they spend looking for the correct type of bread to package. The main impact of this design would be the economic impacts since less bread will need to be wasted due to getting lost and going bad. This could also improve the psychological impacts to the employees since the area will be much more organized and items will be easier to locate.

## VI. Conclusion

San Luis Sourdough currently has issues with efficiency and standardization in their packaging department, ergonomics problems in the packaging department, shipment accuracy in their loading department, and lacks an organized layout design. As a result of this project, we devised three objectives to be met by the end of the six month period.

Objectives:

- An implementation of standardization and an increase in efficiency within the packaging zone
- A decrease in ergonomic issues in the packaging zone
- An increase in shipping accuracy in the loading zone
- An organized layout design

To meet these objectives, data was collected, possible solutions were devised and tested. Standard operating procedures were created for the different types of bread. These were then tested to determine both the accuracy of them and their impact on improving efficiency in the packaging zone. It was noted that the SOPs did increase efficiency in comparison to their current training program. These SOPs will assist San Luis Sourdough with training their current and new associates. The goal is to ultimately decrease their high turnover rate for new hires, while increasing the packaging efficiencies of their current associates. It was discovered that the optimal height for the pallets the packagers utilize to place the bagged loaves in is ten pallets high. However, implementing this would not be possible as the problem stems from their distributors. An implementation plan for a barcode system was devised to assist with implementing in the case that Bimbo Bakeries decides that it is financially feasible. A cost analysis was performed to further provide them with data to support their decision to implement a barcode system. Their current layout was updated as well as transformed into two new layouts. One layout was chosen as the more preferable one and has the potential to be implemented in the

near future the Production Supervisor explained. Each objective was successfully accomplished and the scores to these can be seen in Appendix G.

Impacts:

There are three sets of impacts from the objectives we met: economic, social and environmental. The economic impacts can be seen for our objectives within the loading zone and the facility layout. The cost of implementing a barcode scanning system has a large upfront cost with a long payback period, which could be detrimental to their profits for some time. As for the facility layout, to rearrange the facility would require downtime and extra manpower, which could cause them to lose additional profits as well. The social impacts can be seen within the packaging zone. These associates have been working for ten years or more and have been found to be set in their ways. Upon interviewing a packaging team lead, he explained that the reason for projects like this one failing is that the associates are not willing to change to meet new procedures or standards. These changes could upset these associates and ultimately not occur due to this lack of support. By involving the employees in the changing process, this could curb the lack of support. The environmental impacts are positive as some of the objectives could decrease their waste. The new facility layout will decrease the number of loaves lost due to an inability to find them or see them throughout the facility. The barcode system will decrease the number of inaccurate shipments, which sometimes results from lost loaves as well. In a previous discussion with the Production Supervisor, he noted that they have to pay large sums to companies to dispose of this waste for them. These are the potential impacts as a result of implementing these project objectives.

Lessons:

It was discovered in this project, how important it is to stick to the scope of the project and not get veer off course when other problems arise. While gathering information about the packaging and loading areas, the team was informed of other problems that the employees have with the current system. It was important to make note of this but not try to address these issues as they were outside of the scope of the project. Another discovery for the team was how important hearing feedback from the associates was, since these associates would be directly affected by the outcomes of this project. Many of them also provided additional information about problems that they experience, which was very helpful when brainstorming potential solutions.

Further Recommendations:

Some further problems that need to be addressed at San Luis Sourdough are the:

- Scheduling Problems
    - Currently there are two shifts a day, 12 hours each and this has potential for improvement and will hopefully lower the employee turnover rate if

addressed. A system could be created to determine the optimal shift length and number of employees needed to work that shift.

- A counting system for number of packaged loaves
    - This would all the packaging department to know how much of the shipment quantities they have completed.
- A marking system in the packaging zone
    - Another improvement could be implementing a marking system on the slicing machine to correlate to the sizes of bread. It was observed that setting this machine up to the correct size for the type of bread took a great deal of setup time and decreased efficiencies.
- Improving ergonomics in the packaging zone
    - It was discovered that the optimal height for the stacks of baskets is 4 baskets high to prevent bending over and 10 baskets high to prevent reaching up. More analysis would have to be completed to verify this. The number of these movements was recorded for a thirty minute period and the data suggested a need for a more ergonomic process to be set into place.
- Automating the computations in the loading zone.
    - The loading zone has to manually calculate the number of full and partial stacks to be included in each order, which leads to computational errors. This system could be automated and reduce the number of inaccurate shipments.

Having another group further evaluate some of these further problems would be beneficial in the future.

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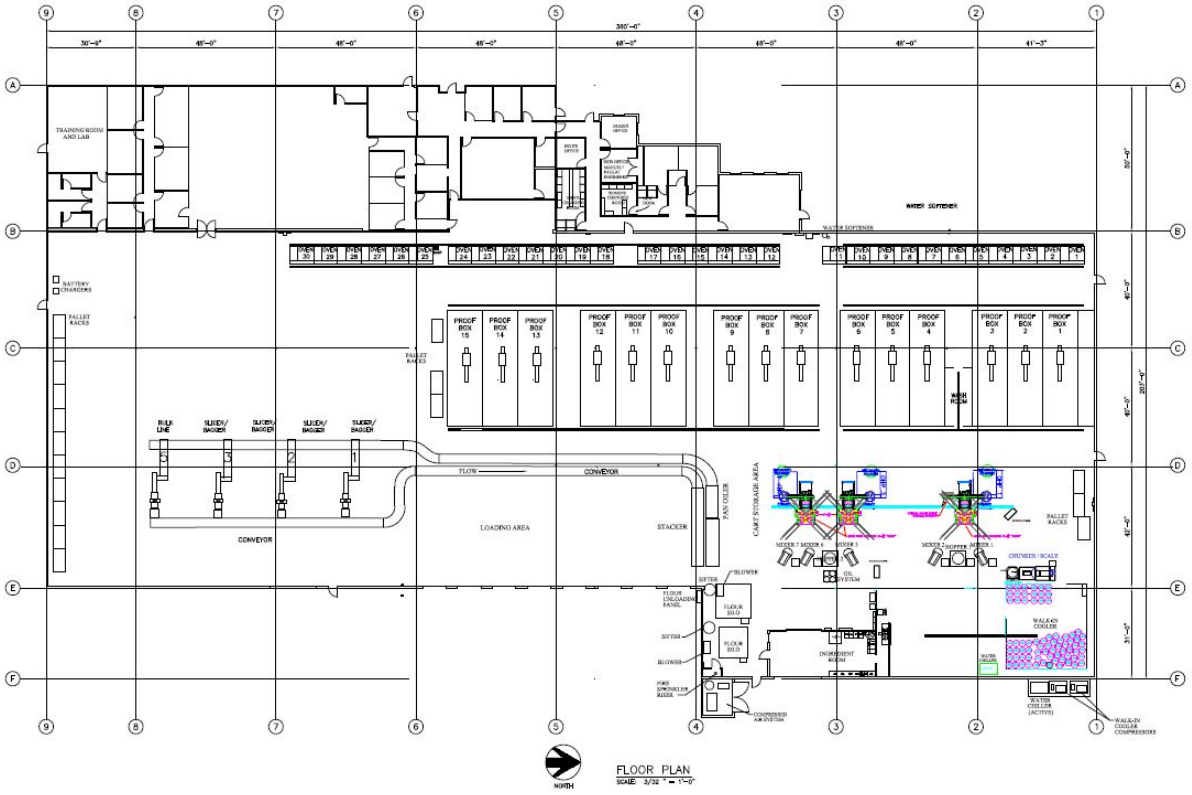
# Appendix:

Appendix A: Complete Facility Layout




Appendix B: Time Studies Comparing Veterans to Newer Hires

| | Veteran Workers (1 stop) | | | Newer Workers (16 stops) | | | |
|---|---|---|---|---|---|---|---|
| Step 1: Tray to bagging | Step 1 | Step 2 | Step 3 | Step 1 | Step 2 | Step 3 | |
| Step 2: Bagging to clip | 1.25 | 61 | 6.86 | 2.18 | 104 | 6.73 | |
| Step 3: Clip to pallet | 0.83 | 70 | 6.9 | 0.70 | 72 | 10.29 | |
| | 1.31 | 58.97 | 4.78 | 1.26 | 75 | 7.88 | |
| | 1.05 | 51.16 | 4.95 | 2.12 | 78 | 5.48 | |
| | 2.40 | 61 | 4.76 | 2.15 | 97 | 5.62 | |
| | 1.63 | 71 | 10.23 | 1.28 | 50 | 4.53 | |
| | 0.75 | 53.12 | 4.35 | 2.26 | 150 | 5.48 | |
| | 1.40 | 60 | 9.59 | 1.76 | 101 | 8.61 | |
| | 1.10 | 66 | 6.56 | 2.43 | 40 | 4.18 | |
| | 1.20 | 62 | 6.58 | 1.28 | 70 | ***12.75*** | **Got stuck in conveyor* |
| **Average time per station** | **1.29** | **61.43** | **6.56** | **1.74** | **83.70** | **7.16** | |
| **Average time overall** | **69.27** | | | **92.60** | | | |

Appendix C: Summary of Veterans and New Hires

| Average Times (Seconds) | | | |
|---|---|---|---|
| **Positions** | **Veteran** | **Newer** | **% Difference** |
| **Feeder** | 1.29 | 1.74 | 29.70% |
| **Slicer** | 61.43 | 83.70 | 30.69% |
| **Trayer** | 6.56 | 7.16 | 8.75% |
| **Total** | 69.28 | 92.60 | 69.14% |

Appendix D: Time Studies Comparing SOPs to No SOPs

| Position | | SOP | No SOP |
|---|---|---|---|
| **Feeder** | 1 | 1.87 | 1.75 |
| | 2 | 1.25 | 2.75 |
| | 3 | 1.54 | 1.86 |
| | 4 | 2.34 | 2.43 |
| | 5 | 1.93 | 1.23 |
| | 6 | 1.32 | 1.35 |
| | 7 | 1.45 | 2.05 |
| | 8 | 1.34 | 1.25 |
| | 9 | 2.23 | 1.40 |
| | 10 | 1.34 | 1.98 |
| | Average | 1.66 | 1.81 |
| **Slicer** | Learning time | 2 min | 5 min |
| | 1 | 150.5 | 182.37 |
| | 2 | 146.42 | 178 |
| | 3 | 137.7 | 176 |
| | 4 | 124 | 185.94 |
| | 5 | 219 | 182 |
| | 6 | 223.99 | 183.79 |
| | 7 | 220 | 280 |
| | 8 | 275 | 240 |
| | 9 | 215.34 | 260 |
| | 10 | 173 | 194 |
| | Average | 188.50 | 206.21 |
| **Trayer** | 1 | 6.35 | 7.41 |
| | 2 | 6.53 | 7.3 |
| | 3 | 6.35 | 8.65 |
| | 4 | 6.5 | 7.53 |
| | 5 | 6.68 | 7.62 |
| | 6 | 6.69 | 8.03 |
| | 7 | 7.05 | 7.31 |
| | 8 | 5.66 | 7.9 |
| | 9 | 7.05 | 8.71 |
| | 10 | 7.13 | 7.01 |
| | Average | 6.60 | 7.75 |

Appendix E: Percent Difference

| Average Times (Seconds) | | | | Percent Difference | |
|---|---|---|---|---|---|
| **Positions** | **Office w/ SOP** | **Office w/o SOP** | **Newer Line Employee** | **% Diff w/ SOP** | **% Diff w/o SOP** |
| **Feeder** | 1.60 | 1.81 | 1.742 | -8.88% | 3.76% |
| **Slicer** | 188.50 | 216.26 | 83.7 | 55.60% | 61.30% |
| **Trayer** | 6.60 | 7.75 | 7.155 | -8.43% | 7.64% |
| **Total** | 196.70 | 225.82 | 92.60 | 38.30% | 72.70% |

Appendix F: Standard Operating Procedure

Standard Operating Procedures
SLO STUBBY 18 oz

Feeder:

1. Bring two racks of bread and place them on either side of the conveyor.
2. For SLO STUBBY 18 oz grab a loaf from the tray on your right making sure the bread is of good quality if it not good quality throw it in the bin. If it is good, place them on the bread conveyor.
3. Once that tray is finished put that tray on lower conveyor for trays.
4. Then repeat step 2 but grab from the tray on your left side.
5. Repeat steps 2-4 until both racks are empty
6. Repeat the process.

Slicer:

1. Grab the sliced loaf with both hands making sure to keep slices together.
2. Slide the bread into the bag.
3. Use your left hand to push the bag into the conveyor.

Trayer:

1. Grab a basket from the stack on the dolly and place it on the line.
2. Grab the bags from the conveyor making sure they are properly tagged if they are not they should be placed into the basket on your right to be retagged, if they are good place them onto the basket.
3. Once there are 10 loaves on the basket place the tray onto the conveyor
4. Grab a new basket from the stack and repeat the process until there are no more baskets on the dolly and stack the empty dollies and then start with a new stack.

Appendix G: Layout Ratings

| Criteria: | Layout 1 | Layout 2 |
|---|---|---|
| The ease to implement | 9 | 8 |
| Allows for easy access to pallets and baked loaves for the packaging employees | 8 | 9 |
| Ability to safely maneuver facility | 9 | 9 |
| Location of the pallet racks. | 7 | 9 |
| TOTAL | 33 | 35 |