# PROCESS IMPROVEMENT OF

# KAISER PERMANENTE MEDICAL GROUP

By

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## Executive Summary

This report seeks to improve the operations of the Kaiser Permanente's Central Refill Pharmacy. In particular, the need for better workstations became evident when witnessing the cluttered appearance of the packing workbenches in the facility. Furthermore, one of Kaiser's largest problem areas is the physical strain caused by the repetitive motion required of the packing job function. A redesign of the packing workstations has been developed on Microsoft Visio in order to reduce clutter, be more space efficient, and decrease eye and arm movement associated with employee strain. The most significant additions are an automated slide that transfers packages from station to conveyor and the change of table orientation.

Another critical issue is the amount of time consumed by the scheduling/assignment process. The need for improved production control was also apparent in collaborating with supervisors who mentioned how long and inefficient the current process was which consisted of manually writing assignments followed by typing them again into a spreadsheet. A new scheduling/assignment system using Microsoft Access been developed which will cut down on the amount of time spent assigning assistants to a specific workstation. The use of drop-down boxes and queries allow the scheduler to select and assign employees without having to type names in or match availability and specialty with open assignments. It will allow supervisors to view an employee's assignment history and quickly search for backup employees.

The proposed designs for the workstation and database were chosen from other alternatives considered. The final selections were made based upon input of both partners as well as the Kaiser point-of-contacts with regards to capacity, usability, functionality, and overall benefit.

## Acknowledgements

We would like to thank the staff at Kaiser Permanente for assisting us with this project. They have been extremely helpful, both in our facility visits as well as our conference calls/email collaborations. During both visits, they took the time out of their busy schedules and spent several hours with us. They did not see us as just students who were completing a project. They treated us as engineers whose talents and imagination could potentially bring great benefits to the company. Alex Ortiz, Steven Kim, and Kim Nakamura have been our main points of contact, and each of them has been very approachable and informative. Craig Koga, Mark Whitehead, Reuben Martinez, and Larry Vankuran are part of the management staff that has also been facilitating our project. Assistant Steven and technician Jessica contributed to our some of our findings as well.

## Introduction

In the interest of improving the operations of Kaiser Permanente's Central Refill Pharmacy packing area, we seek to develop an ergonomic redesign plan and production control assistance that will benefit both the employees and the managers of the facility. In the packing area, workers are responsible for picking the prescriptions, verifying the prescription to the order, packaging them, and labeling the packages before sending the sealed package on a conveyor to get shipped. Over time, several issues of concern have surfaced over the efficiency of this process. In particular, we hope to improve the ergonomics of the workbenches and the procedure of scheduling/assigning employees to their stations.

### Problem Areas

The job functions of the packing area involve a series of repetitive tasks during shifts that range from four to eight hours long. The packaging process begins with the employee picking the order from a tote by either reaching to the left or right side of the workstation, depending on the orientation of the station. They then scan the prescription and perform the task at hand, which could be labeling, verifying, or packing. This is followed by scanning the prescription again and returning it back on the conveyer. After scanning, the employee has to toss the prescription onto a conveyer belt that gets sent to shipping or placed back into the tote. This type of repetitive movement necessitates a standardized method to prevent injury to the individual performing the task. Currently, Kaiser is faltering in this area—the tote packing area encounters high risk of injuries with the left and right hand/wrist, elbow, and shoulder. These injuries are not only detrimental to the company's expenses, but they decrease employee morale as well. Because of this large detriment, the core focus of our project will be applying human factors and ergonomics within the workstation with the goal of minimizing injuries and fatigue.

Besides ergonomics, Kaiser is also experiencing issues in the area of logistics and production control. During our visit, we were told that the assignment and staff scheduling process could take up

to eight hours. Currently, an excel template of all workstations is printed off and employees are manually written in each cell. This allows the supervisor to compare the schedule and the template side-by-side. Afterward, the names are entered into the template on the computer and printed off. This process is inefficient in that names must be entered twice. Furthermore, Kaiser lacks standard operation procedures for rotation of assignments and this has caused some employee angst in that some workers are unhappy that they've been assigned to the same task for several days in a row. Some areas require special training and thus can only be filled by certain people. However, most of the other assignments are done rather arbitrarily, resulting in many workers being assigned the same function without much rotation. Misalignment of staffing requirements also occurs on a regular basis due to the lack of a robust scheduling process or production controller position in the company. When a staff shortage or call-off occurs, supervisors must scramble to find a replacement. They have no method of being able to quickly identify those who are not working during a particular day. Overall, scheduling and assigning is a tedious and time-consuming routine.

## Objectives

The plan to tackle Kaiser's inefficiencies is as follows:

- Re-design the workbenches to allow for optimal user-friendliness
- Reduce the number of injuries per year
- Initiate improved scheduling system that reduces time and error
- Receive approval from Kaiser of possible implementation

## Solution Approach

Currently, the workstations are not very user friendly for the operators. The employee has the option of sitting or standing while working, but does not have a suggested height requirement for his or her adjustable table. This report will determine optimal heights based off of anthropometric scales/ergonomic research and setting visual controls for each operator's height to reduce strain throughout the course of the shift. Furthermore, the arrangements for the workstation at the beginning and end of shifts are also lacking standardized compositions, and this can lead disorganized, cluttered work areas. The position of the equipment makes the operator twist, torque, extend and bend their body every few seconds to complete each prescription. Experiments will take place to determine the optimal workstation design, which will cater to the specific operator's abilities (e.g. height, reach, mobility, etc.). An ergonomic workstation will cut down on injuries and fatigue during the operator's shift and increase the morale throughout the facility.

The extra cost of labor from supervisor hours could be minimized by implementing production control strategies that match streamline the scheduling and assignment process. A dynamic database program will be created to handle staffing in a much more efficient manner. Being able to instantly retrieve an employee's information and query specific information that match with Kaiser's staffing demands should save the supervisors a great amount of time they spend searching for which employee is able to work what shift. The database will include many accessible features such as quick searches based on queries, possible backups upon the click of a button, and preventative actions relating to constraints. These functions will save time as well as reduce error of scheduling.

## Background

Kaiser Permanente is the largest managed health care organization in the United States. The company is comprised of three entities: Kaiser Foundation Health Plan Inc, Kaiser Foundation Hospitals and their subsidiaries, and The Permanente Medical Groups. The focus of our project is on the medical group facility located in Downey, California. Here, the medicine orders are processed, retrieved and filled, labeled, packaged, and finally, shipped to the pharmacies or directly to the patient. Excluding management, the facility is comprised of about 210 employees of assistants, technicians, pharmacists, and supervisors. Approximately 39,235 prescriptions are received here daily.

In 2009, A.T. Kearney consultants conducted a work study analysis of all KP Pharmacy operations and identified several opportunities for improvement. Their general guidelines are the basis for the problem areas we chose to investigate. There are several concepts with regards to ergonomics, operations, and production control that we will be utilizing in our analysis. In our plans for workstation redesign, we will be applying the theories of 5S (Sort, Straighten, Shine, Standardized, and Sustain) to make the operator feel safer and more comfortable while performing their task. With regards to operations and scheduling improvements, we will employ concepts of database design in our scheduling and assignment program.

# Literature Review

In this section, three topics are discussed to help understand the needs for process improvement in this project which are Human Factors, Production Control, and Lean Manufacturing.

## Human Factors

When a task is repeated multiple times a day, a standardized method should be in place to prevent injury to the individual performing the task. Ergonomics and human factors need to be analyzed within the workstation to help prevent injuries and fatigue. The term Ergonomics comes from the two Greek words *ergos* (work) and *nomos* (natural law) and is the scientific discipline that seeks to understand and improve human interaction with products, equipment, environments and systems. Human Factors involves the study of factors and development of tools that facilitate the achievement of enhance performance, increase safety, and increase user satisfaction. Within Kaiser, the workstations are not setup in the most ergonomic fashion. There are high risks for multiple areas of the human body. The parts that are in high and medium risk are the hands and wrists, elbows, shoulders, neck, and back. These injuries are occurring due to a lack of design for the workstation that relates to the job task and ability of the employee.

Industrial workstations tend to be thrown together for employees in many companies without much scientific thought about ergonomics and human factors. Businesses take little consideration in the design of a workstation relative to the ability of the operator and their respective task requirements. An ergonomic approach to the design of the workstation provides the worker with both physical and mental well-being, job satisfaction and safety. Even the smallest changes in workstation dimensions can have a considerable impact on employee productivity, and occupational health and safety (Das, 1996).

In designing an industrial workstation, there exists a systematic approach. The first objective is to obtain relevant information on task performance, equipment, posture, and environment. For Kaiser,

the tasks at hand are labeling, verifying, and packing prescriptions. To obtain this information, one must conduct one-on-one interviews and take surveys from the employees that are performing the task on a daily basis. The objective of surveying would be to record the general employee rating of various equipment/system design and environment factors, the current level of fatigue after a shift on the employee, and the change in postural discomfort (Das, 1995).

The following ten step systematic approach came directly from Das and Sengupta study about determining a workstations design parameters design:

1. Obtain relevant information on the task performance, equipment, working posture and environment through direct observation, video recording and/or input from experienced personnel.
2. Identify the appropriate user population and obtain the relevant anthropometric measurements o r use the available statistical data from anthropometric surveys.
3. Determine the range of work height based on the type of work to be performed. Provide an adjustable chair and a foot rest for a seated operator and an adjustable work surface or platform for a standing operator.
4. Layout the frequently used hand tools, control and bins within the normal reach space. Failing that, they may be placed within the maximum reach space. Locate control or handle in the most advantageous position, if strength is required to operate it.
5. Provide adequate elbow room and clearance at waist level for free movement.
6. Locate the displays within the normal line of sight.
7. Consider the material and information flow requirements from other functional units or employees.

8. Make a scaled layout within drawing of the proposed workstation to check the placement of individual components.
9. Develop a mock-up of the design and conduct trials with live subjects to ascertain operation-workstation fit. Obtain feedback from the interest groups.
10. Construct a prototype workstation based on the final design (Das, 1996).

The overall goal of human factors is to design a workstation that can help reduce human error, increase productivity, and enhance safety and comfort (Wikens, 2004). The workstations need to accommodate a range of different body types, such that the there will be clearance for the largest user and the smallest user can reach for an item or object. A good percentile to aim for is 95% of the population of the workstations. The experiments that are conducted to determine the design of the workstation needs to be normalized otherwise the data will not have significant results.

## Production Control

One of Kaiser's prime opportunities for improvement is in the area of production control. Staffing wise, the company has been experiencing issues in which staff shortages result in high levels of overtime and improper assignment. The extra cost of labor could be avoided by implementing production control strategies that match scheduling to the appropriate throughput of that period. Currently, the ratio of supervisor to staff is 1:52, which is relatively low as it does not allow for much floor supervision over the packers. Aside from staffing, Kaiser has also been having troubles with the current workflow system. There is not enough predictability to ensure smooth operations and preparedness in order to avoid bottlenecks and dissonance in workflow.

Kellogg has experienced the benefits of implementing a production control system called KPS (Kellogg Planning System) which utilizes operations research and capacity planning. Kellogg runs KPS each Sunday morning to guide production decisions in week 2 and beyond. KPS makes production,

packaging, inventory, and distribution decisions at a weekly level of detail. The model uses the production, inventory, and demand recursion:

$HOLD_t = HOLD_{t-1} + MAKE_t$ - Demand$t$

for all time periods (weeks) *t*, where *HOLDt* is the inventory for a single product at the end of period *t, MAKEt* is the production of the product during time period *t* and Demand*t* is the exogenous demand for the product during period *t* (Dantzig 1959; Zangwill 1969). Each Kellogg plant or co-packer is modeled as a set of processing lines that produce products, which then feeds a set of packaging lines that pack finished skus.

The decision variables are as follows: MAKE *t*—Production of products on a processing line, PACK: Packaging of skus on particular packaging lines, HOLD: Inventories of skus, SHIP: Shipments of skus to or from other plants and DC (Brown et. al 2001). These variables are accompanied by the following constraints: processing and packaging line capacity does not get exceeded, all products produced in a week gets packaged into skus, each sku balances inventory from previous week plus current packaging and shipments plus demand at plants, safety stock requirements are satisfied, the system coordinates processing lines and packaging lines as needed (Brown et. al 2001). Some of these constraints are elastic, meaning that violation results in a penalty cost.

The data utilized by KPS include inventory and shipping costs, penalties for unmet demand, production and processing line capabilities, forecasts, and variation in nominal yields. Several of these are variable throughout the year, which is why KPS must be run every week. Similarly, Kaiser may necessitate a fulltime production controller due to the variability in volume and demand they experience. Similar to Kellogg's data, useful information for Kaiser's analysis would include order forecasts, assembly line capabilities, penalties for late delivery, variation in yields, and staffing/level of service requirements. For KPS, the greatest uncertainty is in actual demands for skus. In the first few weeks of a time horizon, demand numbers are more accurate because they are based on orders from

customers, but starting at week three, actual demands depart from the initial forecast. So KPS uses safety stocks, that is, minimum inventory levels, as a buffer for uncertain demand. Planning personnel meet prior to the start of a quarter to schedule production and packaging for that upcoming quarter. Planners will compare the schedule against a weekly run of KPS so they can make adjustments and to identify any approaching risks of unmet demand. For example, if KPS shows a processing line being heavily utilized for a particular product, planners will enforce a regular schedule with production every week on that line using a whole shifts.

The success of KPS depends heavily on accurate forecasts. Kaiser may be able to benefit by having accurate forecasts or predictions of volume in order to staff accordingly. Six Sigma can be employed to improve operational performance as well as the accuracy of forecasts. K.K. Chang and F.K. Wang, authors of "Applying Six Sigma Methodology to Collaborative Forecasting," note that quality tools can be applied to supply chain areas, such as mapping of supply chain processes, process standardization, process variation control, supplier certification, total customer satisfaction, auditing, preventive and corrective action and supply performance measurement. They proposed a continuous improvement model for forecasting.

The first module, DEFINE, pinpoints what type of data is needed for forecasting and the time period in which such a sale was done in order to produce the historical and holdout forecasts. With regards to Kaiser, the most appropriate data may be statistical order volume/trends and amount of throughput. MEASURE refers to the collection of data of all the products involved in the collaborative forecasts. The ANALYZE module evaluates the current performance in order to re-evaluate the standards to be met for forecasting accuracy. Kaiser currently has issues with determining accurate levels of volume in order to match with scheduling. It would be beneficial to estimate and analyze the costs of extraneous labor in order to evaluate current performance and how that cost can be lowered. In the IMPROVE module, changes that would improve forecasting accuracy are implemented. The last

module, CONTROL, evaluates the variation between what is forecasted and the actual amount is be monitored using control charts (Chang and Wang 2009). The authors suggest the use of Mean Absolute Percent Error (MAPE) in order to measure improvement and maintain control. The equation is as follows:

$$\mathrm{M} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|$$

where $A_t$ is the actual value, $F_t$ is the forecast value, and n is number of periods

If Kaiser implements either a production controller position or assigns that function to an existing employee, control will be pivotal part of continuous improvement so that error may be diminished over time with further analysis.

## Lean Manufacturing

Kaiser representatives alluded to the company attempting to function as lean as possible. In a plant that conducts operations 24 hours a day, any seemingly small process improvements may be significantly beneficial. Several research studies have shown that a lean strategy produces higher levels of quality and productivity as well as better customer responsiveness (Krafcik and Nicholas, 1998). Lean can appreciably reduce lead times and increase velocity in flow and the supply chain. A study by Zayko et al. (1997) points that lean manufacturing can result in a 50 percent reduction of human effort, manufacturing space, tool investment and product development time, and a 200-500 percent improvement in quality.

A key concept in lean is the notion of adaptation, which involves making appropriate responses to technological changes and learning from other organizations that have achieved the best practices in the industry (Freeman and Perez, 1988). Authors Stuart So and Hongyi Son of “Supplier Integration for Lean Manufacturing Adoption” defines technology management as “improvement of existing

manufacturing processes through streamlining, reorganizing or restructuring the layout and set-up, e.g. using cellular layout, so that waste can be reduced and response time can be minimized" (2010). Although Kaiser relies heavily upon technology, a large majority of their processes are manually operated. An investigation into more automation would potentially be beneficial, as well as implementation of more technology to assist the employees.

Behind every machine, there is an operator, which is why people are just as important as technology. So and Hongyi define people management as "the development of human capitals to support continuous improvement objectives through creating proper work environment for employees from the president to the hourly workers towards this objective. This includes the empowerment and training of workforce or establishing autonomous team" (2010). Shams Rahman, author of "Impact of Lean Strategy on Operational Performance," confers that employees should be trained in multiple skills and possess redundant capabilities. Not every employee of Kaiser is cross-trained. However, this may be a part of their strategy to have workers specialize in one function so that they are experts and perform at optimal efficiency each day. This may come at the cost of employee boredom and lack of enrichment. Employee satisfaction may be a big issue, and using lean concepts could improve motivation and performance. Since Kaiser has been experiencing staffing issues, it would be useful to probe into how often employees are required to work overtime due to shortages in workers who can perform a specific function.

Rahman narrowed down lean manufacturing to thirteen operational improvements:

1) Reducing production lot size;

(2) Reducing setup time;

(3) Focusing on single supplier;

(4) Implementing preventive maintenance activities;

(5) Cycle time reduction;

(6) Reducing inventory to expose manufacturing and scheduling problems;

(7) Using new process equipment or technologies;

(8) Using quick changeover techniques;

(9) Continuous/one piece flow;

(10) Using pull-based production system/Kanban;

(11) Removing bottlenecks;

(12) Using error proofing techniques/Pokayoke; and

(13) Eliminate waste

Based on the facility visit and our observations, numbers 2, 5, 7, 8, and 12 are especially applicable to Kaiser's operations. Reducing set-up time (2) and having a quick changeover between shifts (8) would be one of the goals of an ergonomic re-design of the workstations. Employees often have to adjust their bench when they first come in, rearranging items from the way it was left by the previous employee. The redesign would also relate to pokayoke and error-proofing (12) of employee functions. Cycle time reduction (5) and bottleneck reduction (11) would be related to an improved operations process flow of Kaiser's standard operating procedures, which we will analyze. The "cherry-picking" (workers choosing the easiest bottles to work with) of totes will be an issue that can be improved to enhance process flow. New process equipment and technologies relates to what was mentioned above about adaptation and automation.

This literature review has facilitated our project, particularly with respect to the design phase. We have used the guidelines for optimal ergonomics in our new design for Kaiser's packing workstations. We have systematically gone through each of Das and Sengupta's ten steps during our approach. Principles of Lean Manufacturing have also been employed within our project. The DMAIC process of Six Sigma was our approach to producing our workstation design. We also took into account Rahman's thirteen operational improvements in our database design. We sought to reduce setup time (2) and cycle time (5), introduce new technology (7), and error proof the system (12).

# Design – Workstations

We approached this portion of the project using the following DMAIC project methodology under the concept of Six Sigma.

## DEFINE

A Kaiser Permanente employee (Assistants, Technicians, and Pharmacists) must verify, label, and pack the prescription that flow through the Central Refill Pharmacy. Pharmacists are responsible for verifying that the correct prescription matches the label. Assistants are assigned to multiple areas within the facility, mainly tote packing & sort tray manual packing. The Technicians are responsible for labeling the prescriptions that come from the A-Frame area and manual packing. The workstations are positioned along three conveyer sections that have specific responsibilities depending on the location of the conveyer. At each workstation there is a computer, keyboard, barcode scanner, label printer, and for packing a plastic bag dispenser with a heat sealer and a printer. The workstations are setup in pairs along the conveyer, and employees have the option of picking a workstation that works from either side. The employees have the option of sitting or standing while working and can adjust the height of the table and chair, but there exists no standard heights specific to the employee.

The employees working on the packing line pick the prescription order(s) from a tote by either reaching to the left or right side of the workstation, depending on the orientation of the station. Then scan the prescription and perform the task at hand, which could be labeling, verifying, or packing. This is followed by scanning the prescription again and returns it back on the conveyer. After the employee scans the prescription in the packing areas, he or she often has to toss the prescription onto a conveyer belt that sends to shipping or placed back into the tote. The distance the employee has to toss the package is roughly three to four feet. The issue of this task concerns the repetitive arm motion. The standard times for the areas described are at most twenty-three seconds per order and sums up to one

hundred twenty-four prescription packages per hour per employee. That repetition can lead to injuries to the shoulders, elbows, wrists, back, neck, and strain to the eyes.

The workstations at Kaiser do not have a standard setup that has been analytically designed to prevent injuries. Currently, the employees have the freedom to adjust the table height to their liking which is not necessarily the best ergonomic choice. The option of using a chair is a prime example. A chair at a workstation can limit the movement of the employee and sometimes limits support to the back. This causes stress to the employee's back from having to twist side to side to pick up totes. Additional strain comes from leaning forward in the chair. Giving the employee the freedom to adjust the height of the table is not always the best option because he or she may place the table too low, which will cause lower back pain. In turn, the employee might put the table too high, which will cause fatigue in the shoulders and arms.

## MEASURE

The framework of our redesign was based off of all the improvements we declared were necessary from the current conditions. As mentioned earlier, we saw the packing workstations as cluttered and ergonomically ill-fitting. Figure 1 is a photograph of a typical packing workstation:

Figure 1: Current tote packing workstation.

The current workstation was drafted up with information from Kaiser Management and measurements taken during observation. Figure 2 and 3 below is a detailed drawing of current conditions for both orientations:

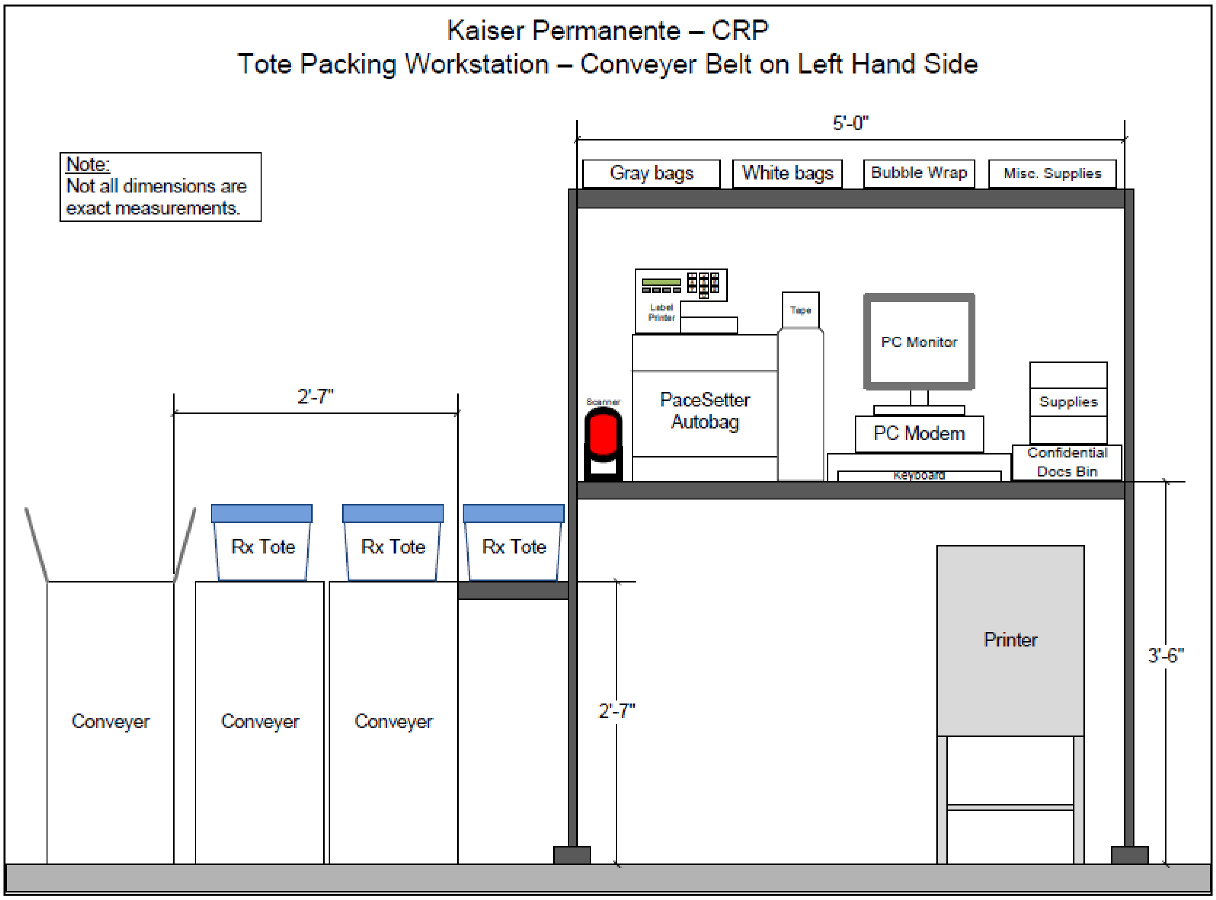



**Figure 2: Current design for Tote Packaging Workstation with conveyor belt on the left side.**

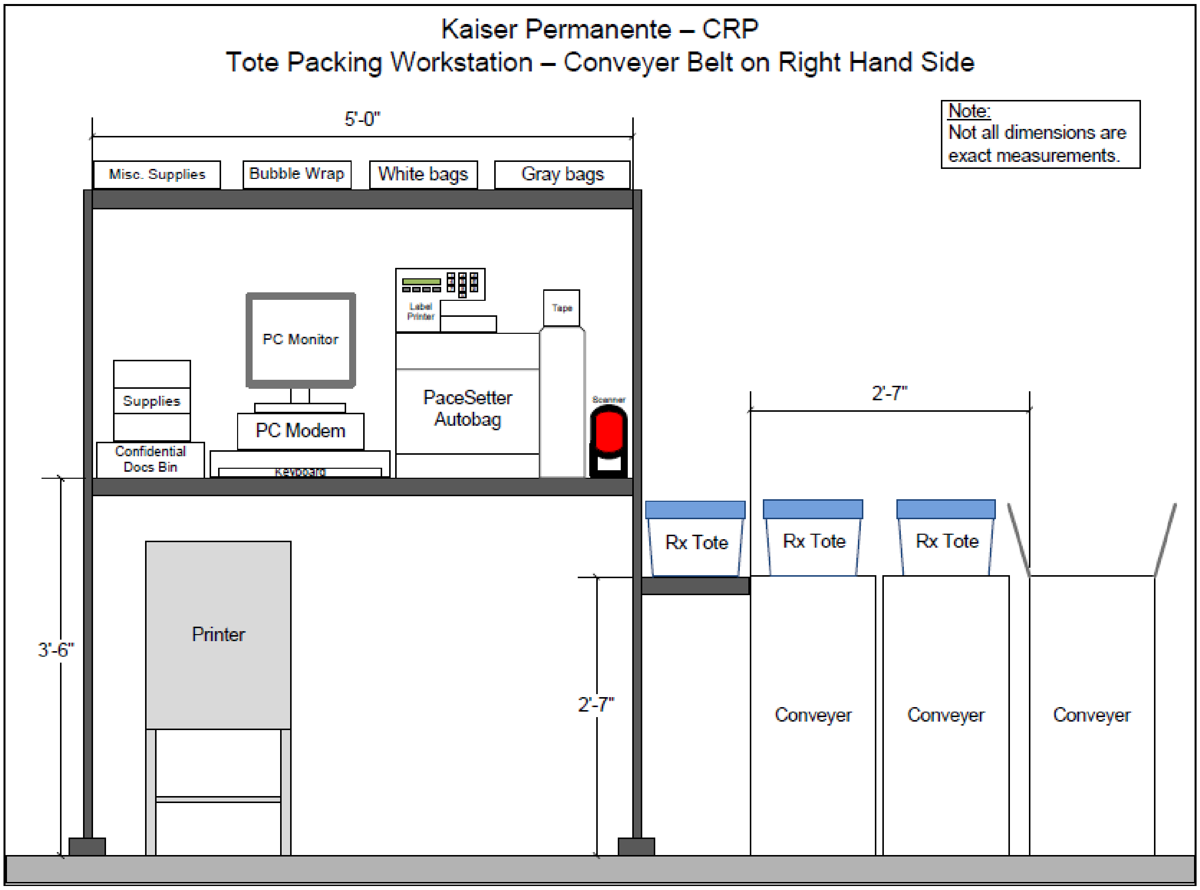



Figure 3: Current design for Tote Packaging Workstation with conveyor belt on the right side.

We used this drawing with regards to overall structure and arrangement of items as a basis for our design improvements. We also conducted time studies, which are mentioned in the Methods section, of packing cycles. The average time of one packing cycle came out to 19.44 seconds. In our final analysis, we will estimate the number of motions saved throughout an eight hour shift using this information.

## ANALYZE

Several problems are associated with the current design. To begin with, about a quarter of the table space is taken up by supplies such as rolls of paper that are very rarely utilized. These items could easily be stowed away underneath the table with a new workbench of shorter length or greater utilization. The keyboard also consumes space even though it is rarely used.

Though poor space utilization is one of our major concerns, the largest and most pressing issue we tackled was the physical strain associated with the packing job function. Even before our project was defined, Humantech Consulting analyzed the risks of tote packing and created the following assessment:

*Ergonomic Priority*

| Job Hazard Score |
|---|
| 32.0 |

| Hand/Wrist | | Elbow | | Shoulder | | | | |
|---|---|---|---|---|---|---|---|---|
| Left | Right | Left | Right | Left | Right | Neck | Back | Legs |
| High | High | Medium | High | Medium | High | Medium | Medium | Low |

**Figure 4: Ergonomic study for the Tote packing workstations completed by HumanTech.**

Figure 4 categorizes the risks of each body part that is put under pressure during the job. Hand, wrist, and elbow are considered high risks because of all the reaching from tote to bag to printer to labeler to conveyor. Although the items are placed in close proximity to the operator to minimize horizontal movement, there is room for improvement with regards to height and vertical movement.

Much of the risk regarding shoulder, elbow (high on the right because most people are right-handed), wrist, and back is attributed the throwing motion of tossing the finished package onto the conveyor. We gleaned this from both the Kaiser staff as well as our own observations of the packers. Kaiser lacks automation to reconcile this troublesome motion.

Neck is considered a medium risk. This strain occurs when the packer must pick the tote at the beginning of the cycle and throw package at the end of the cycle. Something that was not included on this chart but is still considered an ergonomic priority is the eye strain associated with the eye movement from tote to computer to bag to printer to conveyor in just one cycle of packing. The parallel position of the workstation with regards to the conveyor causes much of the neck twisting and some of the eye movement. A favorable change in orientation for the workstation may ease the eye and neck movement.

# IMPLEMENT

Though we will not actually implement our plan, we will generate objectives and develop a plan to meet them in hopes that Kaiser will decide to implement our ideas.

## Objectives

After analyzing the current problem areas, we came up with the following list of objectives for redesign:

- Create a more space efficient table and minimize clutter.
- Incorporate ergonomic suggestions for optimal vertical movement reduction.
- Integrate automation to eliminate the throwing motion of packaged bag to conveyor.
- Reduce neck and eye strain associated with the job function.

## Alternative Design

The first design we considered was a simple rearrangement of items on the workstation. Though this would not be very transformational or meet all of our objectives, it would be the most cost-effective. It could also serve as a basis for more detailed designs. The idea was tested during our second facility visit. We transferred the position of the monitor so that it faces the conveyor. The current setup has the monitor oriented on the opposite side of the conveyor. This causes the operator to twist their neck from one side to the next. To reconcile this, we physically brought the computer to the other side and rearranged the remaining items in a somewhat arbitrary fashion to accommodate the monitor placement. After we were satisfied with our composition, we performed a time study of several cycles to test an operator's performance. Unfortunately, the seasoned employee was dissatisfied with our arrangement because it caused him to twist his body more frequently. When we moved the monitor to the left side of the table facing the conveyor, we had to move to bag dispenser and sealer to the right side. The operator would then be forced to bring the bag closer to the conveyor to throw it. Having to check the monitor against the printed label caused another twist during the beginning of the cycle. Though we reduced neck motion, we increased torso/back movement overall.

This idea was quickly scrapped. If it were to say that he liked it, we would have conducted a more detailed and extensive Design of Experiment.

## Final Design

Our final design, Figures 5 & 6, is shown below. Here, we have developed solutions to each of the problem areas previously mentioned.

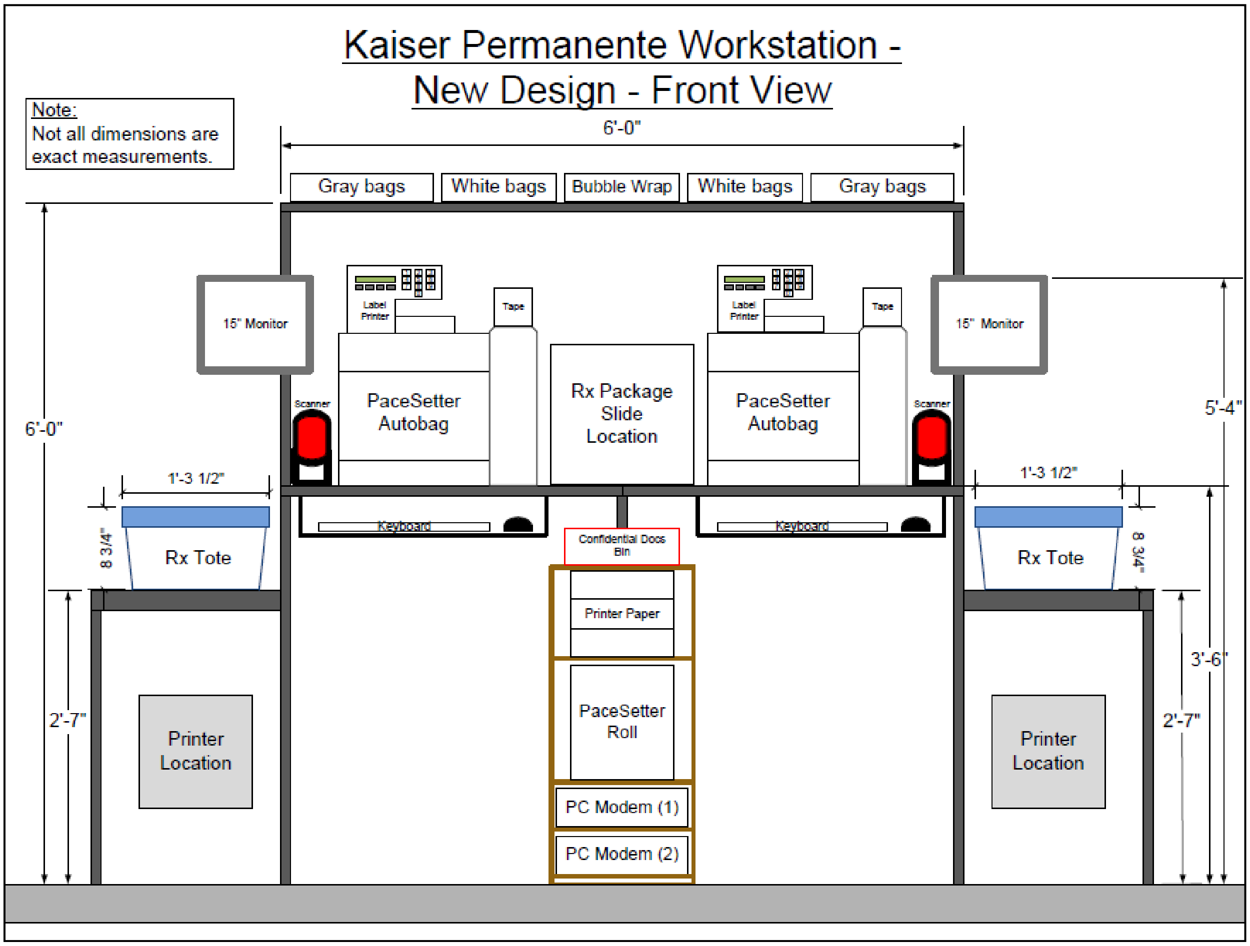



Figure 5: Front view of the new design for the Tote packing workstations.

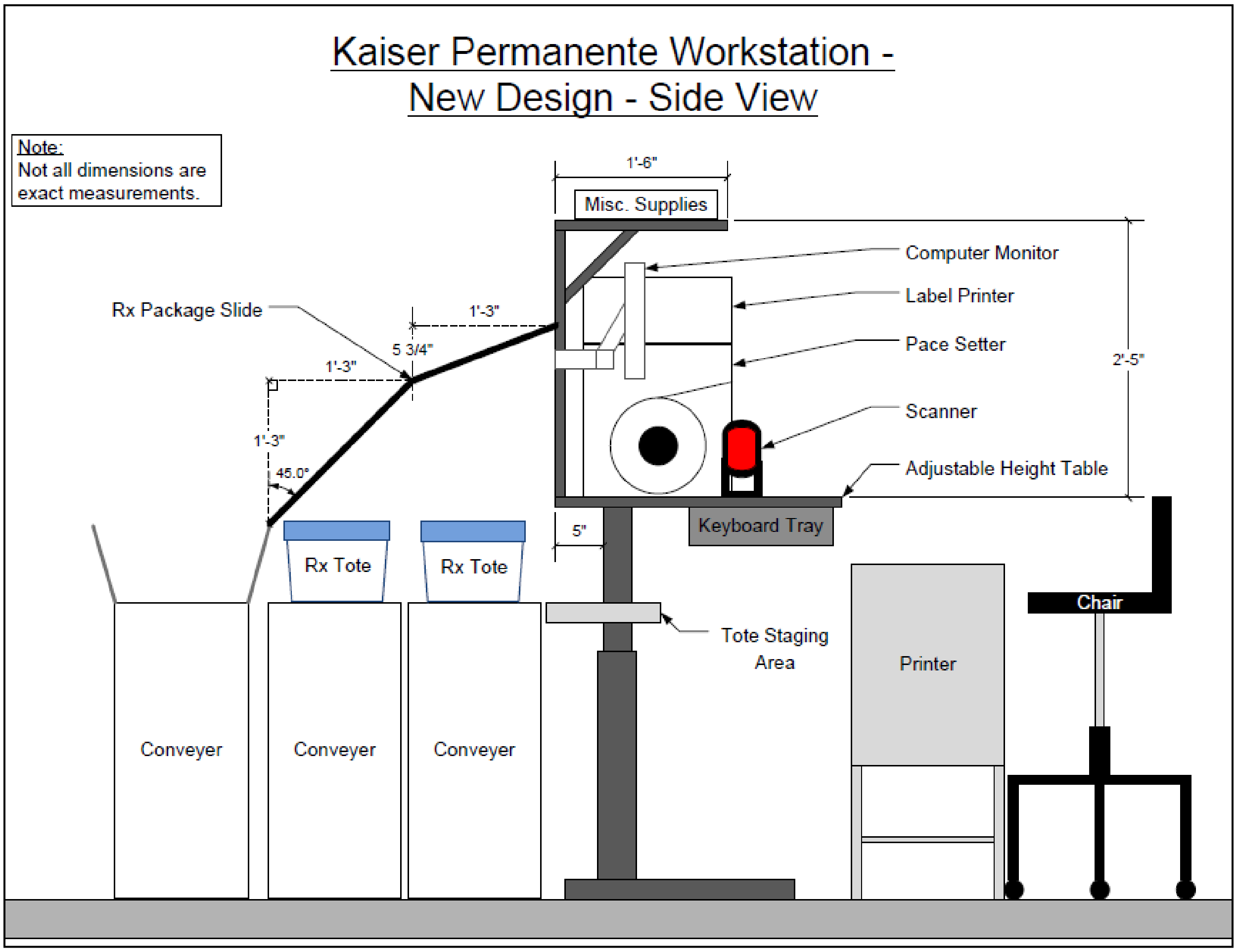



Figure 6: Side view of the new design for the Tote packing workstations.

We have combined two tables and placed them next to each other. The amount of space taken up by each individual workstation has been reduced from five feet to three feet. The utilization has been improved dramatically. The supplies and the keyboard have been moved to a shelf below the table, an adjustable arm for the computer monitor has been mounted on the side columns of the table. These adjustments have allowed us to save two feet of space on the surface.

In-between the two workstations lies a slide that the two workstations share which is used to transfer finished packages from the workstation to the conveyor. This will eliminate the throwing motion, reducing the risk of elbow, neck, wrist, and back strain/injury. Furthermore, the orientation of the workstation has been changed so that the operators would be facing the conveyor belt. Previously,

the workstations were placed parallel to the conveyor, causing the operator to turn when throwing the package. We have rotated the tables 90° so that the workers are now facing the conveyor and no longer have to twist to grab the tote or send it to the conveyor. Figure 7 is a top view side-by-side comparison of the current orientation versus our new design. Figure 8 is a close-up of one workstation under the new design.

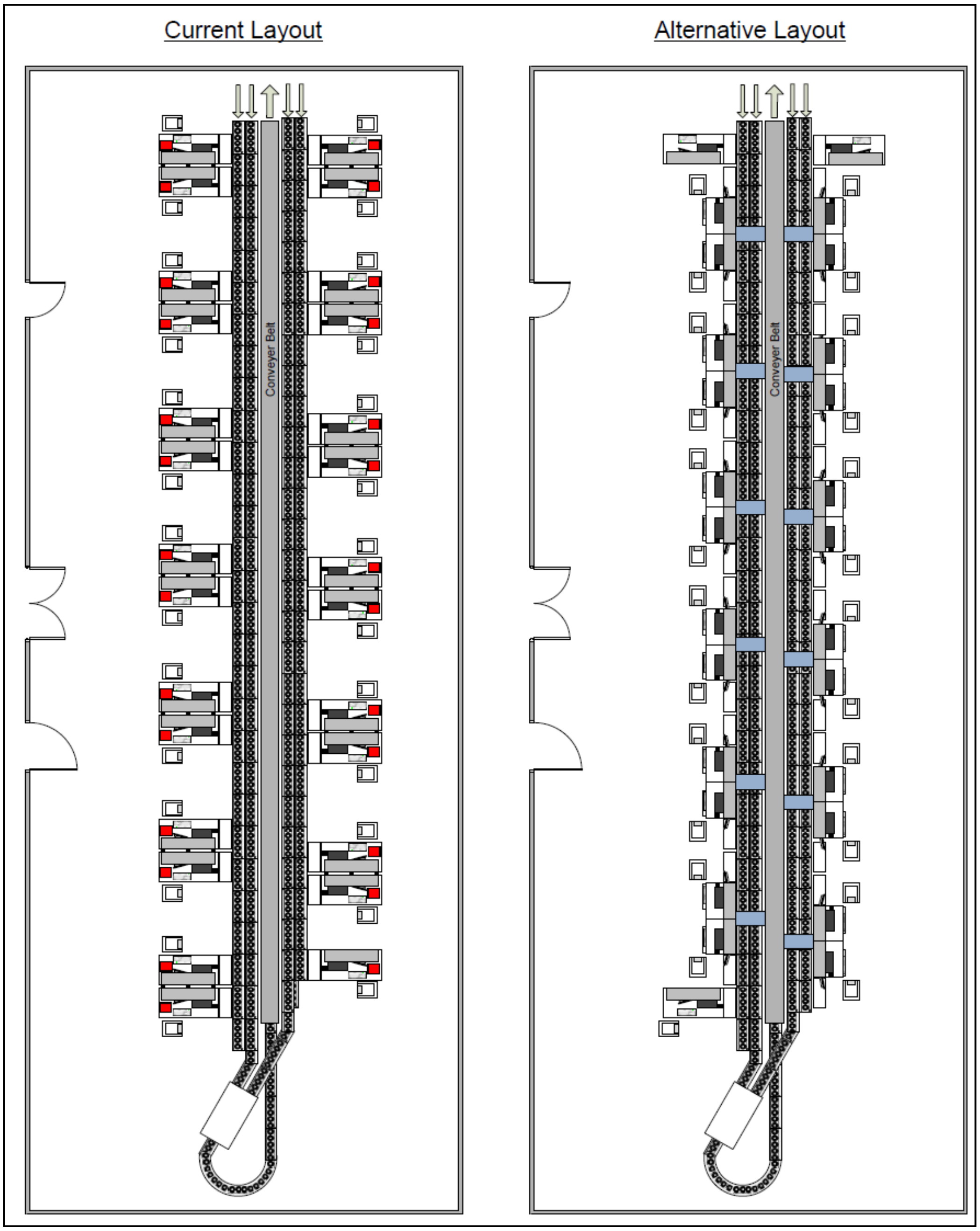



Figure 7: Top view of the overall Tote packing line, showing both the current and alternative layout.

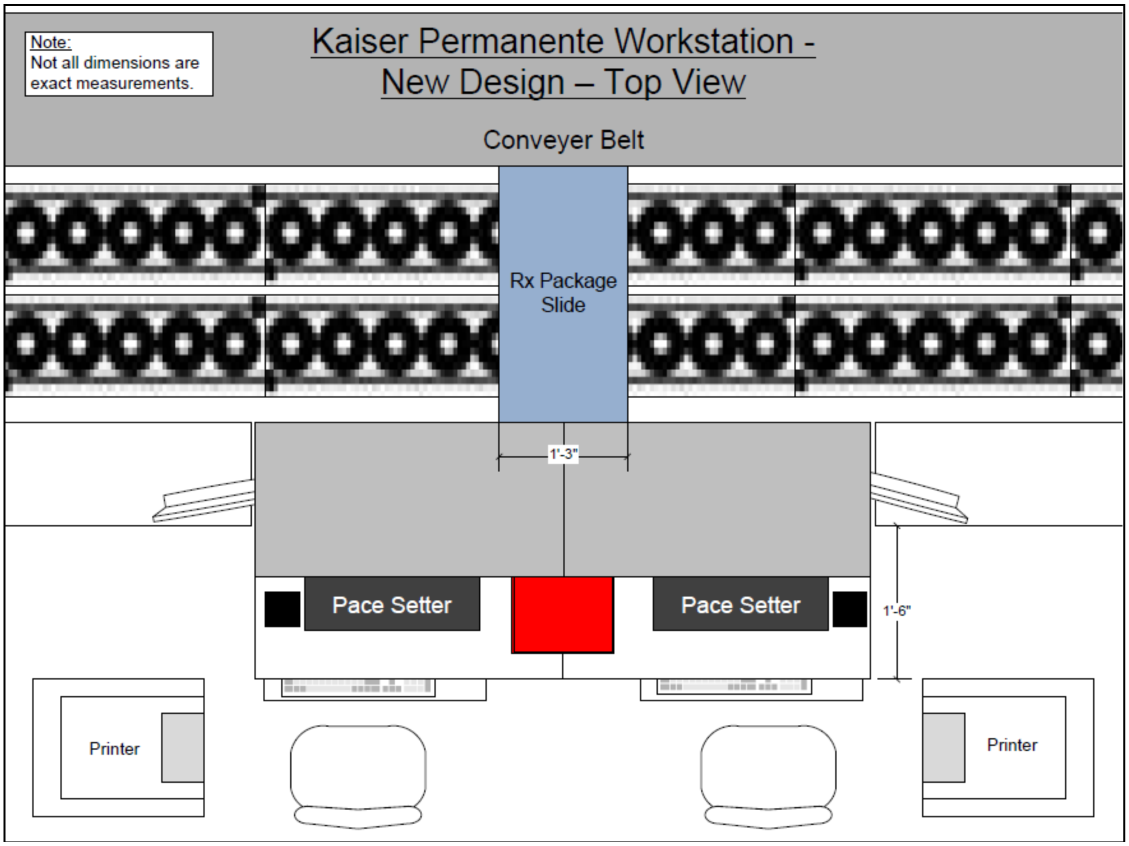


Figure 8: Top view of the alternative workstations.

Our simplest suggestion will be integrating a yard stick next to the table with several line markings to indicate where the table should fall for different heights, either sitting or standing. The operator will be able to adjust the table accordingly in an ergonomically optimal fashion.

## Control

In order to track improvements, we will suggest the following control actions to Kaiser, should they choose to implement our design:

- After one year has passed, compare the nonconformance reports of that year against the previous one to see improvements in injury and strain.
- Compare throughput rates with the new workstations against prior data to see if there is an improvement in performance.
- Interview the employees after a couple weeks to get their input on how they feel about their new workstations.

## Design – Assistant Database

The most challenging aspect of our database involved its design. Since Kaiser did not task us with this specific project, we had no definitions of results and structure. We had to use our imaginations to apply our knowledge of Microsoft Access and create ideas of ways we would be able to streamline the scheduling/assignment process. In many instances, our initial ideas did not pan out in the end.

### Objectives

Though Kaiser did not give us any deliverables, we generated the following objectives of our database, based upon our abilities and what we learned about the troubles they were having.

- Eliminate the need for a schedule/assignment side-by-side comparison.
- Allow for the positions and employees that have already been assigned to "disappear" from the remaining list.
- Allow for new employees to be added or current employees to be deleted from the record.
- Allow for information to be updated with as much or more ease than updating on Excel.
- Create a feature which will assist with position rotation throughout the week.
- Create a feature that would allow supervisors to easily search for back-ups.
- Overall, reduce the time consumed by scheduling/assigning.

### Requirements

After taking all of these goals into consideration, we generated the following requirements which would correspond to each objective:

- Queries which will pull up names and positions that correspond to each department.
- Set-difference queries that will eliminate names/positions once they have been assigned.
- Update query that will add new employees to the system.
- Delete query that will erase employees who leave the company.
- History text-boxes that utilize "D-lookup" to obtain previous positions of each employee throughout the course of a week.
- "Set-difference" query that will show the employees who are not working, but are available, for each day.

## Alternative Design

We began with a design which looked very similar to the template that the supervisors use on Excel to fill in each position cell with an employee name. This type of structure was the easiest to imagine after having learned about the assignment process. We also thought that the supervisors would be comfortable with this because of the similar appearance. The original design, which corresponds to one day of assignment, is shown below in Figure 9:

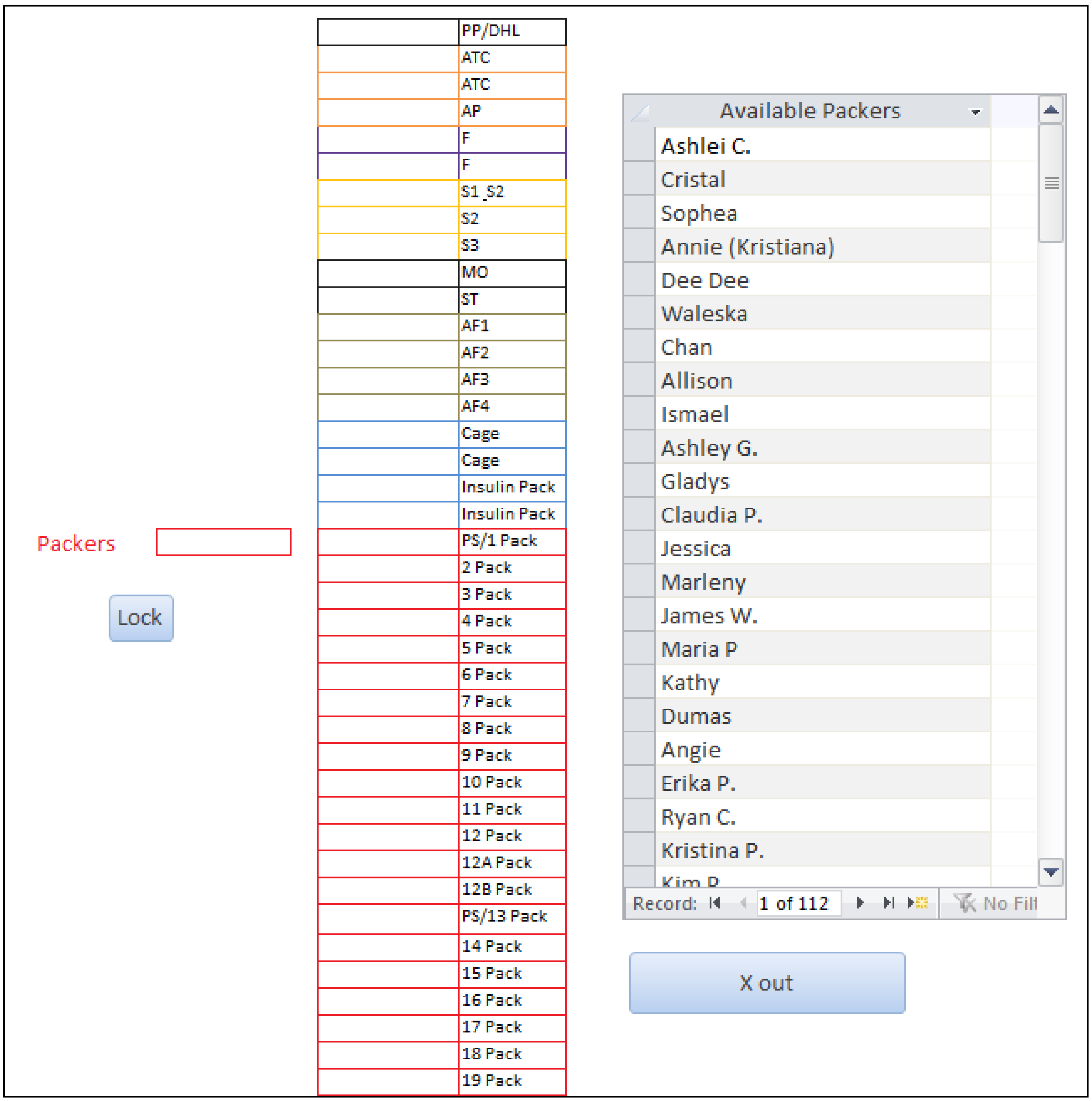



Figure 9: Original alternative for scheduling and assignment process.

In this design, the supervisor would see every employee who is working for the specified day, time, and position in the Subform which is linked to a query. He or she would then copy/paste that name into the cells, which are composed of textboxes. The “X-out” button is clicked every time this happens to eliminate that employee’s name from the Subform list. When every employee has been assigned, the Subform will be empty. There are several benefits to this design. The Subform and template give a side-by-side comparison of available employees and the workstation assignments. The supervisor is able to copy/paste names rather than manually writing and typing it in. The “X-out” button facilitates the process of ensuring every employee has been assigned.

However, many drawbacks are also associated with this design as well. We were having difficulties figuring out how to append both the employee name as well as the position to a history table. The only way to reconcile this with the design would be to have the supervisor paste the name twice: once in the text box and once in a separate text box of the department. This is shown in the figure above with the textbox labeled “Packers” and button called “Lock.” We realized that this method did not look very professional and was somewhat inefficient with all of the clicks that were required. Furthermore, if the supervisor forgot to cross off a name, that person may be assigned twice, creating confusion.

With this in mind, we formulated a better design and forwent the original one. Our new design has a much more professional look to it. More importantly, the user-friendliness is enhanced. Nothing needs to be typed in, because all of the information is listed in one of the three drop-down boxes. The assignment process of one person is done in a matter of four clicks. The tabs represent each shift so that all shifts in a day as well as the history boxes can be included on the same form. Shown below are screenshots accompanied with explanations of each form:

## Switchboard

The switchboard is the page that automatically appears once the database is loaded. It acts as a "main menu" showing the supervisor all the options. A screenshot of the switchboard form is shown below in Figure 10.

### Revise Assignments

If a supervisor needs to go back to a day and assign more people, each day button will bring them to the form.

### View Schedule

Each of the buttons will display the assignments for the specified day chosen.

### Search for Back-ups

Each of the buttons will bring up a report that shows all the employees who are available to work for that day but not scheduled. This allows supervisors to quickly search for backups.

### Add/Delete/Update

These buttons bring the supervisor to forms that allow him or her to enter a new employee, delete one who is leaving, update anyone's availability, or view everyone's current availability.

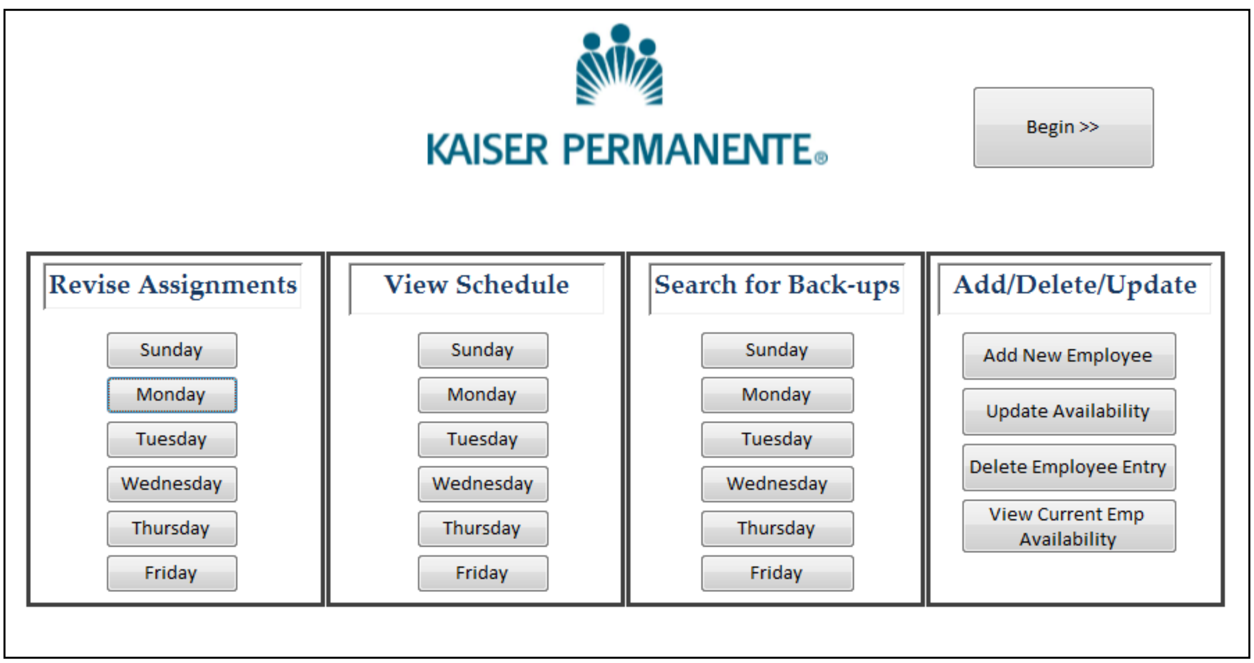
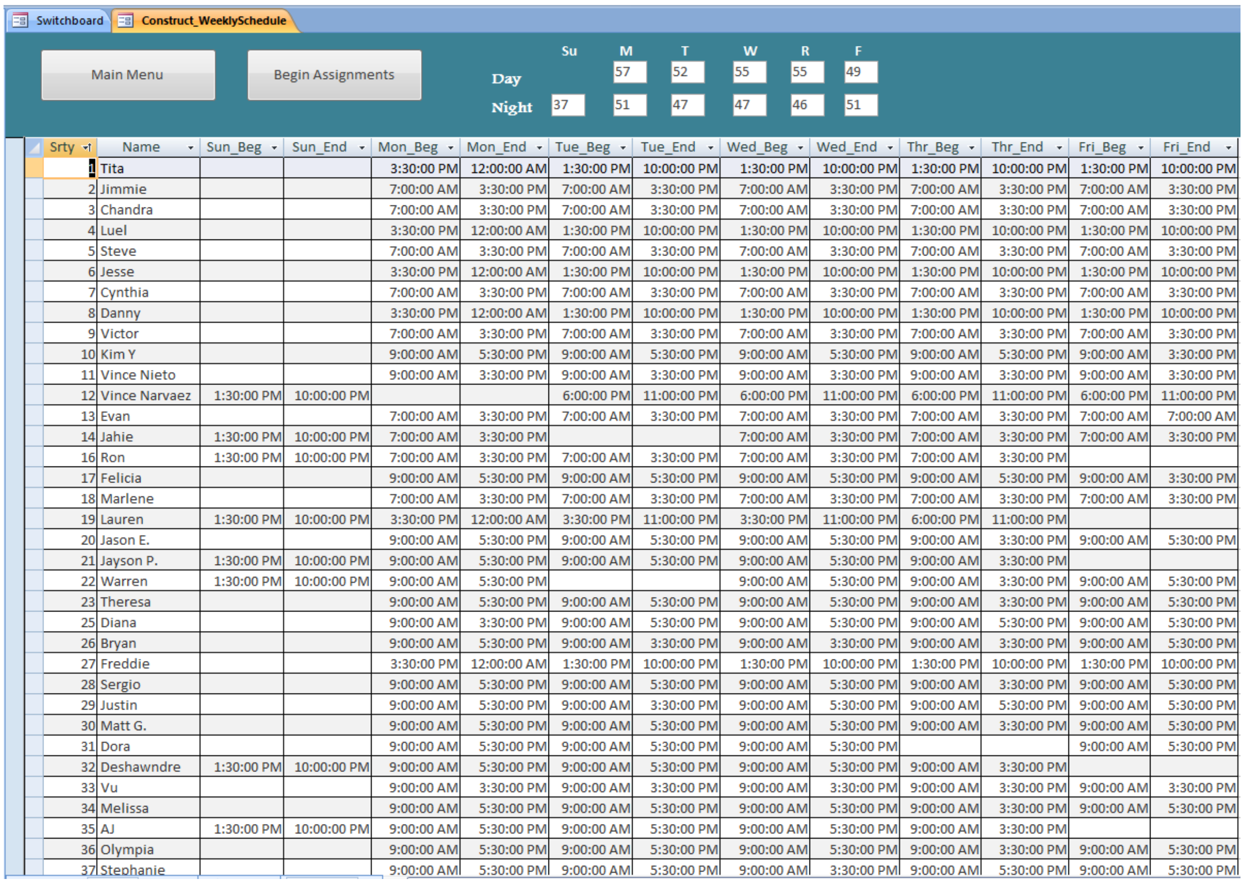



Figure 10: Main menu for scheduling and assigning.

## Construct Weekly Schedule

Here, the supervisor sees the table of availability and cuts everything down to fit the week's schedule. When the form is edited, the table automatically updates to the changes. As shown in Figure 11.




| | Su | M | T | W | R | F |
|---|---|---|---|---|---|---|
| Day | | 57 | 52 | 55 | 55 | 49 |
| Night | 37 | 51 | 47 | 47 | 46 | 51 |

| Srty | Name | Sun_Beg | Sun_End | Mon_Beg | Mon_End | Tue_Beg | Tue_End | Wed_Beg | Wed_End | Thr_Beg | Thr_End | Fri_Beg | Fri_End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tita | | | 3:30:00 PM | 12:00:00 AM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM |
| 2 | Jimmie | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 3 | Chandra | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 4 | Luel | | | 3:30:00 PM | 12:00:00 AM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM |
| 5 | Steve | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 6 | Jesse | | | 3:30:00 PM | 12:00:00 AM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM |
| 7 | Cynthia | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 8 | Danny | | | 3:30:00 PM | 12:00:00 AM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM |
| 9 | Victor | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 10 | Kim Y | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM |
| 11 | Vince Nieto | | | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM |
| 12 | Vince Narvaez | 1:30:00 PM | 10:00:00 PM | | | 6:00:00 PM | 11:00:00 PM | 6:00:00 PM | 11:00:00 PM | 6:00:00 PM | 11:00:00 PM | 6:00:00 PM | 11:00:00 PM |
| 13 | Evan | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 7:00:00 AM |
| 14 | Jahie | 1:30:00 PM | 10:00:00 PM | 7:00:00 AM | 3:30:00 PM | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 16 | Ron | 1:30:00 PM | 10:00:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | | |
| 17 | Felicia | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM |
| 18 | Marlene | | | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM | 7:00:00 AM | 3:30:00 PM |
| 19 | Lauren | 1:30:00 PM | 10:00:00 PM | 3:30:00 PM | 12:00:00 AM | 3:30:00 PM | 11:00:00 PM | 3:30:00 PM | 11:00:00 PM | 6:00:00 PM | 11:00:00 PM | | |
| 20 | Jason E. | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 21 | Jayson P. | 1:30:00 PM | 10:00:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | | |
| 22 | Warren | 1:30:00 PM | 10:00:00 PM | 9:00:00 AM | 5:30:00 PM | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 23 | Theresa | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 25 | Diana | | | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 26 | Bryan | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 27 | Freddie | | | 3:30:00 PM | 12:00:00 AM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM | 1:30:00 PM | 10:00:00 PM |
| 28 | Sergio | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 29 | Justin | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 30 | Matt G. | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 31 | Dora | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | | | 9:00:00 AM | 5:30:00 PM |
| 32 | Deshawndre | 1:30:00 PM | 10:00:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | | |
| 33 | Vu | | | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 3:30:00 PM |
| 34 | Melissa | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 35 | AJ | 1:30:00 PM | 10:00:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | | |
| 36 | Olympia | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM |
| 37 | Stephanie | | | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 3:30:00 PM | 9:00:00 AM | 5:30:00 PM | 9:00:00 AM | 5:30:00 PM |

Figure 11: Availability table can be updated for the entire week before assigning positions.

## Day Forms

Once the schedule has been constructed, the supervisor will then begin the assignment process, starting with Sunday and ending with Friday. Our design is self-explanatory and user-friendly. Below are the steps to the process:

1) Choose a department from the Department drop-down box.
2) Choose position within from the Positions drop-down. The drop-down is linked to a query so that only positions within the department will appear.
3) Choose an employee from the Name drop-down, linked to a query that only shows those who are available for that shift, day, time, and position.
4) To view the selected employee's previous positions from the past five days, click the "See History" button and the positions will appear in the boxes.
5) Click the assign button. This records the information that has been entered.
6) Advance to the next tab of the next shift and repeat steps 1-5.
7) When finished with the day, click the button on the top right corner of the form to advance to the next day.
8) After finishing with Friday, click the "Print Assignments" button.

Figures 12-17 shown below are screenshots of each day form and show the process on how to add an employee to a position on a given day and shift.

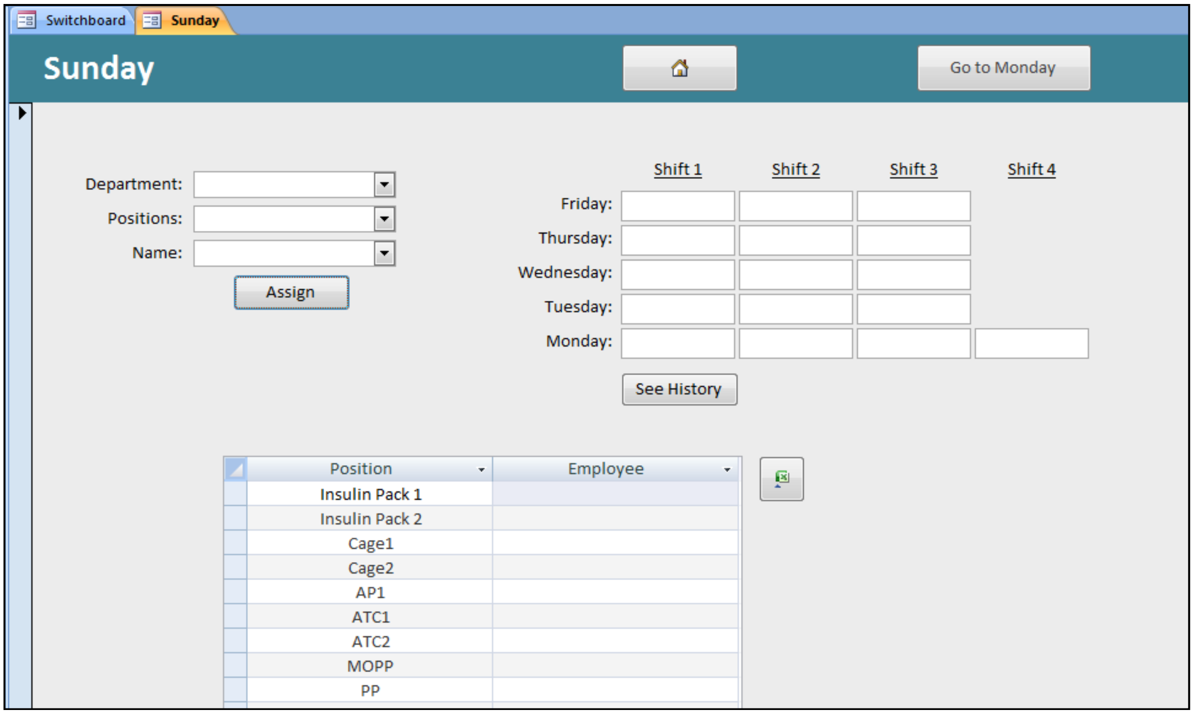



Figure 12: A Template of the assignment form for scheduling employees.

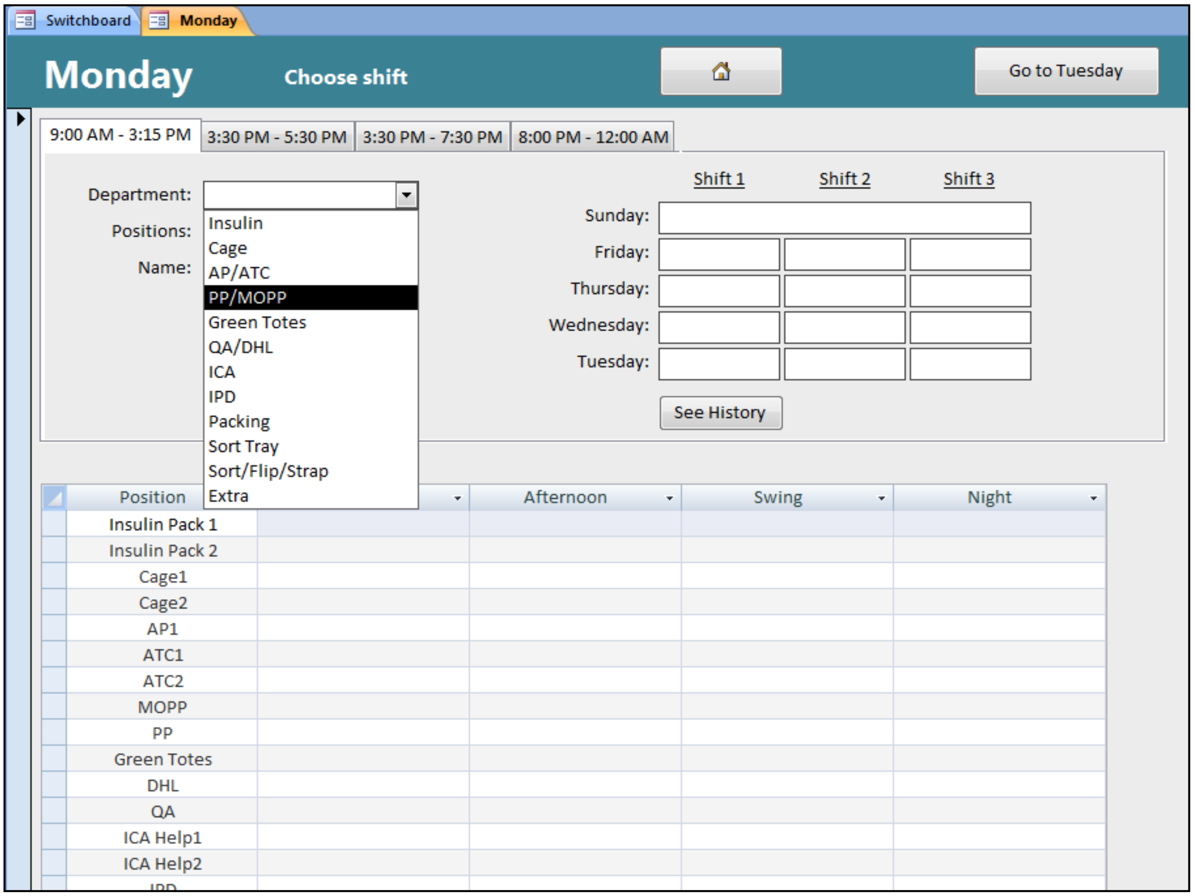



Figure 13: Monday form, showing the Department dropdown list.

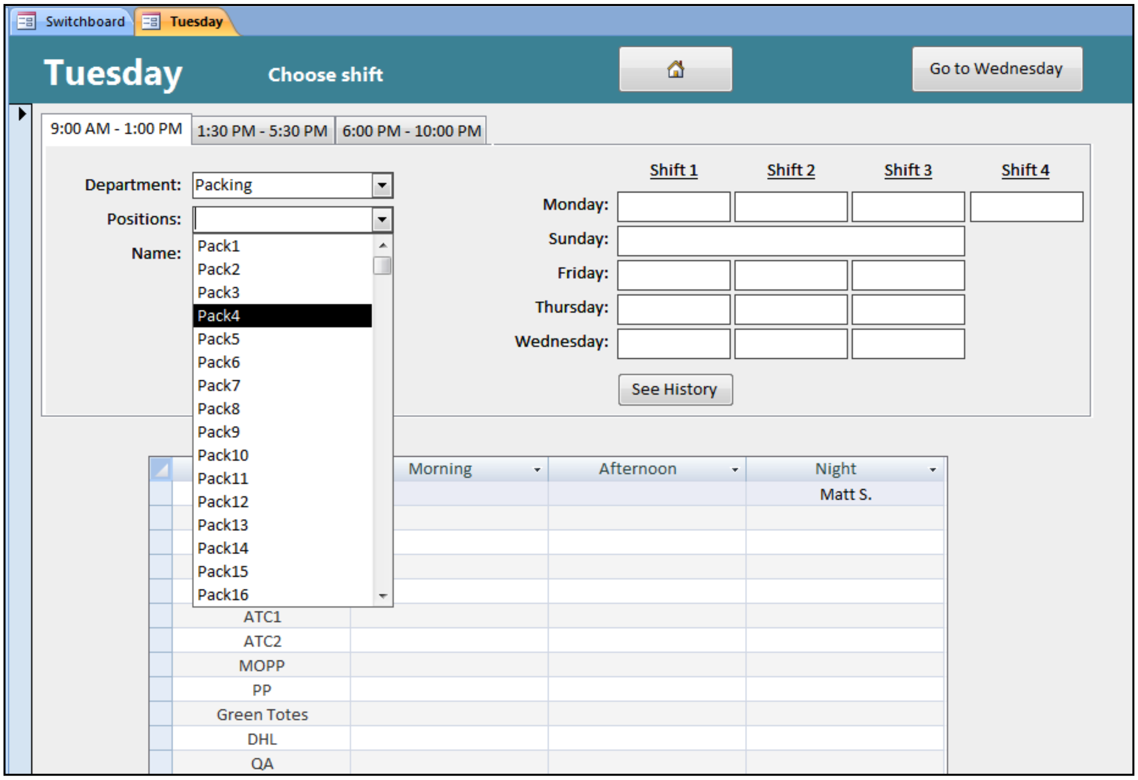



Figure 14: Tuesday form, showing the Positions for the Packing Department.

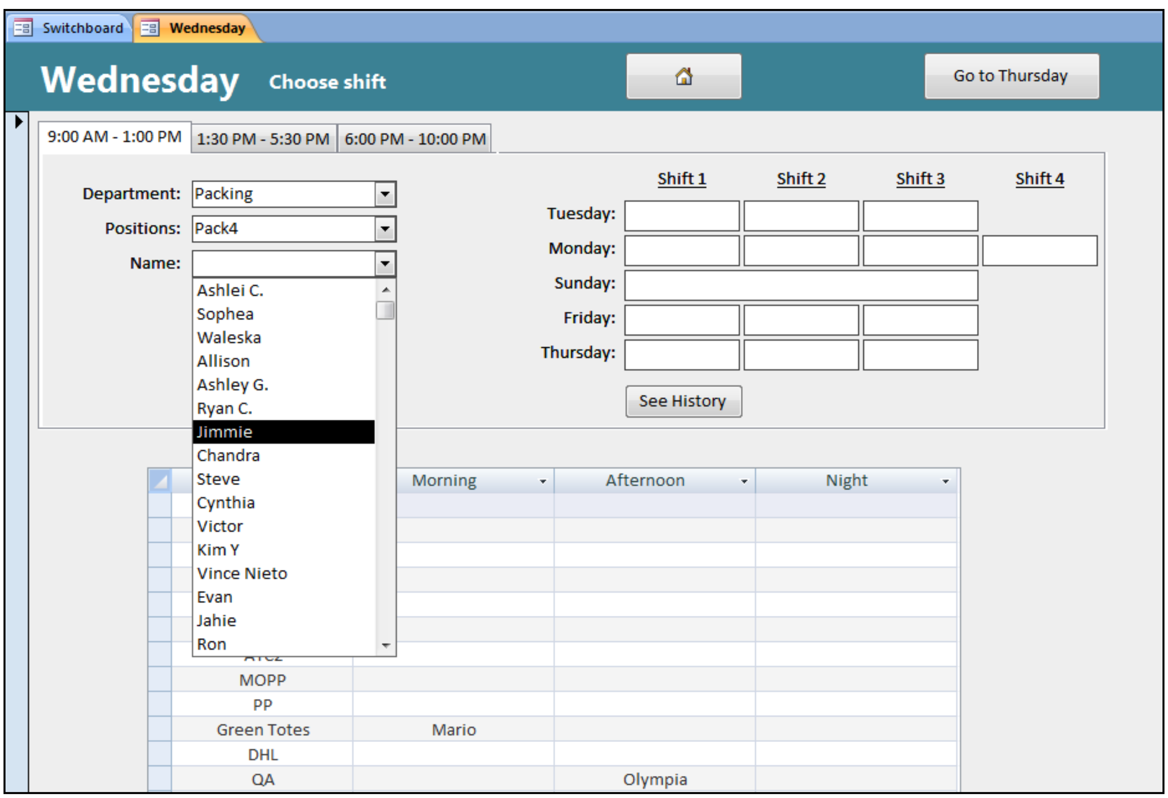



Figure 15: Wednesday form, showing the names of Assistants that are available the Morning shift in the Packing department.

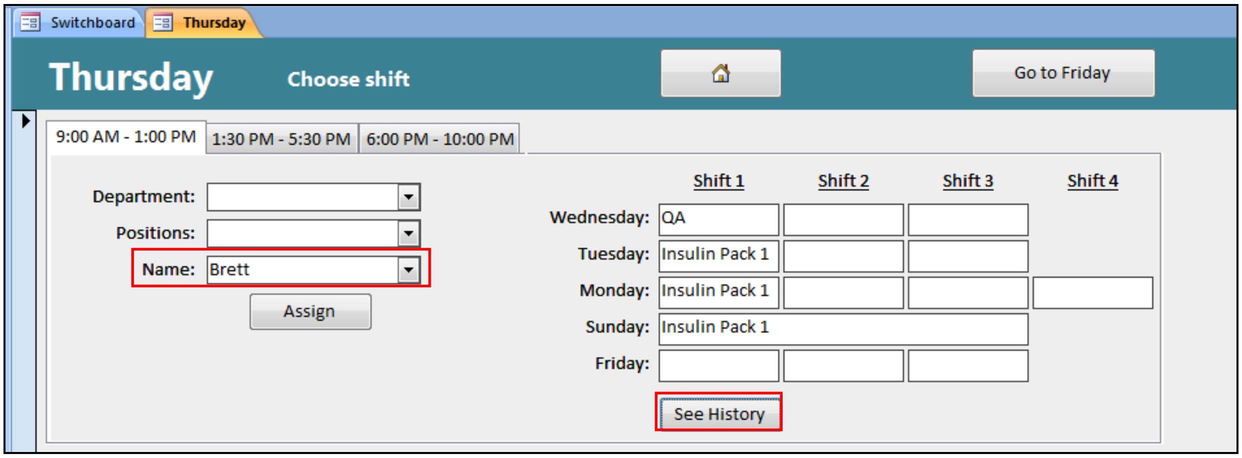



Figure 16: Thursday form, showing the History function on the form for the employee selected.

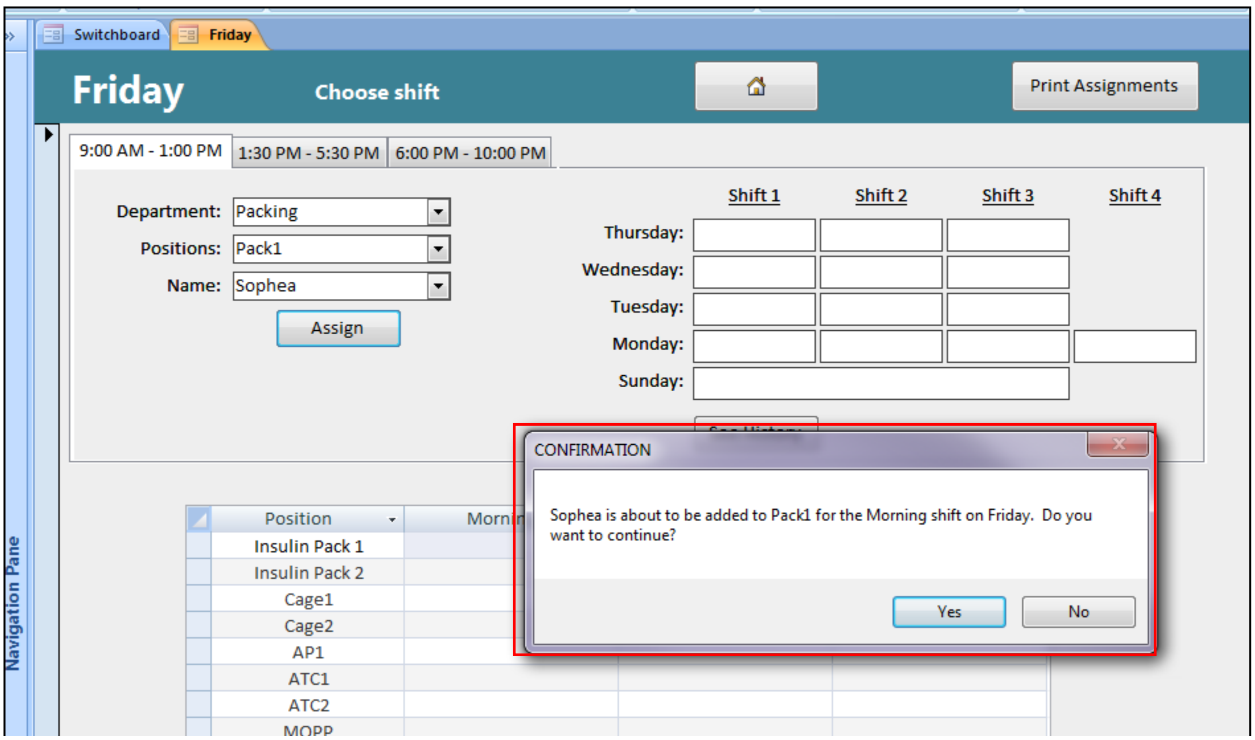
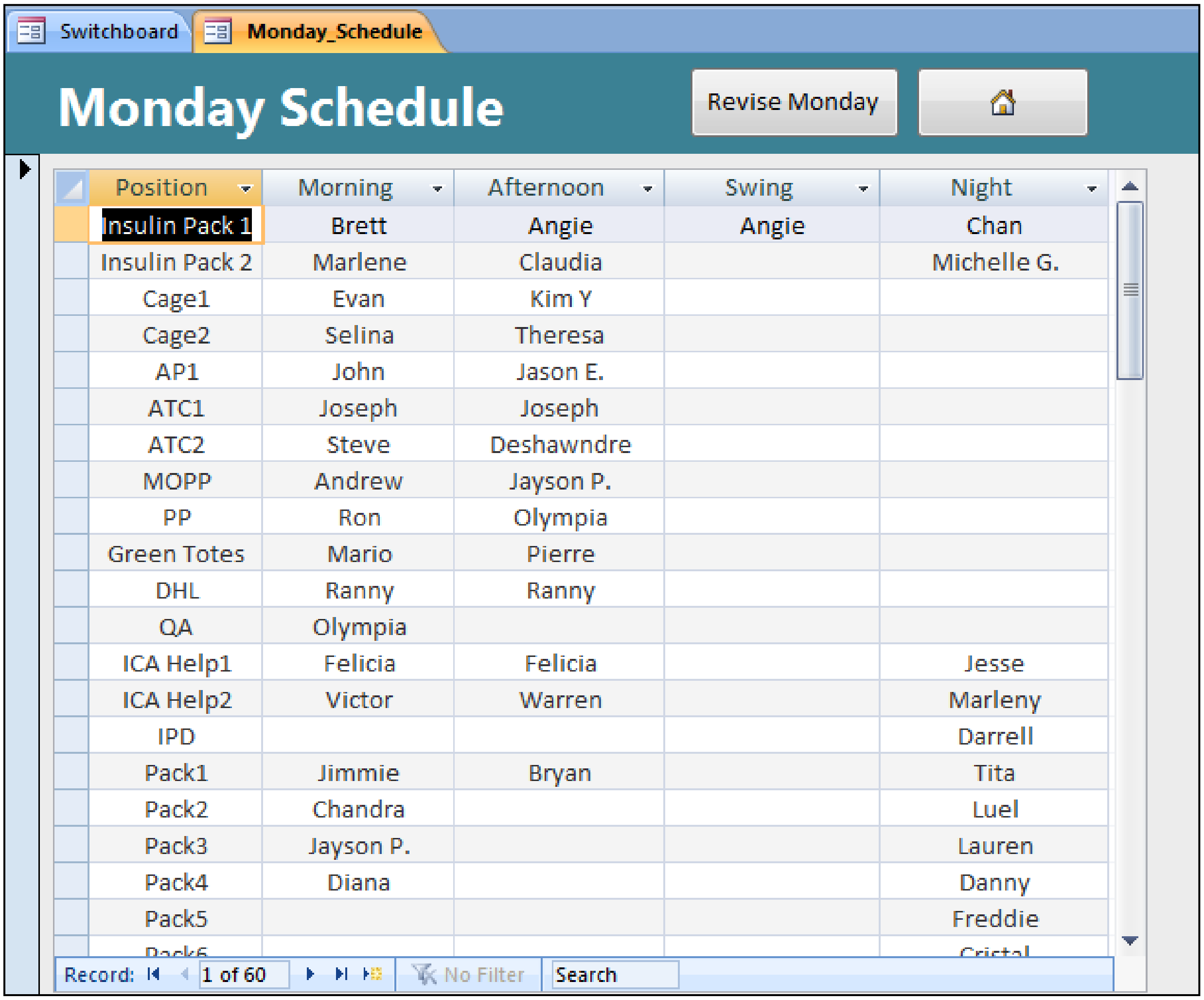



Figure 17: Friday form, showing the "Confirmation" pop-up to verify that employee to the specified position.

## Save Assignments

After the week has been completed, the supervisor will print out an Access-generated report which lists out each employee's assignments for each day.  Below is an example of Monday's report in Figure 18:




| Position | Morning | Afternoon | Swing | Night |
|---|---|---|---|---|
| Insulin Pack 1 | Brett | Angie | Angie | Chan |
| Insulin Pack 2 | Marlene | Claudia | | Michelle G. |
| Cage1 | Evan | Kim Y | | |
| Cage2 | Selina | Theresa | | |
| AP1 | John | Jason E. | | |
| ATC1 | Joseph | Joseph | | |
| ATC2 | Steve | Deshawndre | | |
| MOPP | Andrew | Jayson P. | | |
| PP | Ron | Olympia | | |
| Green Totes | Mario | Pierre | | |
| DHL | Ranny | Ranny | | |
| QA | Olympia | | | |
| ICA Help1 | Felicia | Felicia | | Jesse |
| ICA Help2 | Victor | Warren | | Marleny |
| IPD | | | | Darrell |
| Pack1 | Jimmie | Bryan | | Tita |
| Pack2 | Chandra | | | Luel |
| Pack3 | Jayson P. | | | Lauren |
| Pack4 | Diana | | | Danny |
| Pack5 | | | | Freddie |
| Pack6 | | | | Cristal |

Figure 18:  Monday Schedule, which can be saved to Excel and printed.

## Add New Employee

When a new hire needs to be entered into the system, the supervisor must input his or her seniority, name, availabilities, and positions the employee is qualified for.  Figure 19 shown below is the add form:

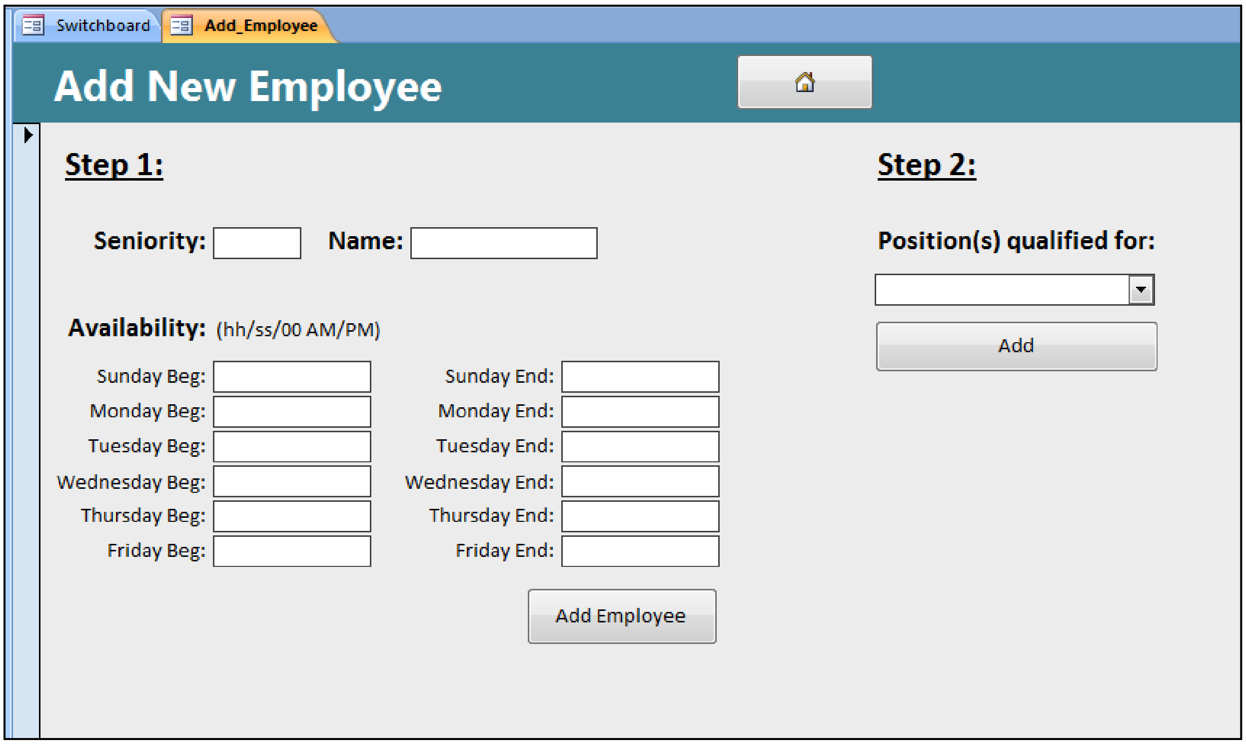



Figure 19:  Add new employee form.

## Delete Employee Entry

When an employee leaves the company, his or her name must be erased from the system so that it does not appear when the assignment process is taking place. In our form, the supervisor simply selects the worker from the drop-down box and clicks the delete button. Shown below is the delete form.

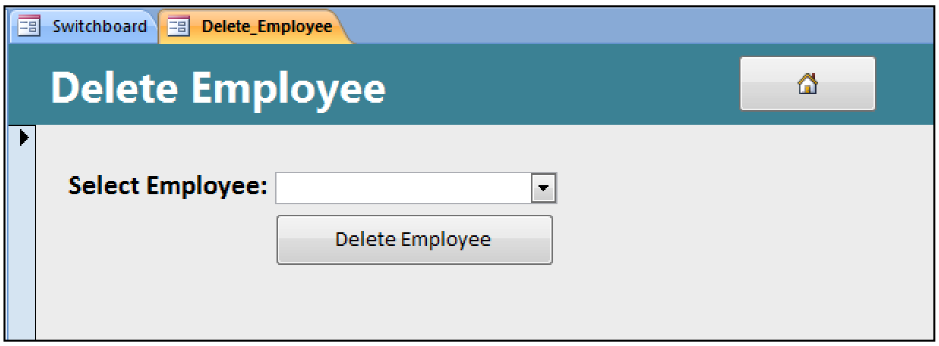



Figure 20: Delete employee form.

## Update Availability

Many times, an employee will need to change their available times to work. In our database, the supervisor will upload the update form and select the worker from the drop-down box. The employee's current availability will appear on a template and the supervisor will make any necessary changes. If the worker is trained in a new area, the area will be selected from a drop-down box and added to the system. The form is shown below with one employee selected:

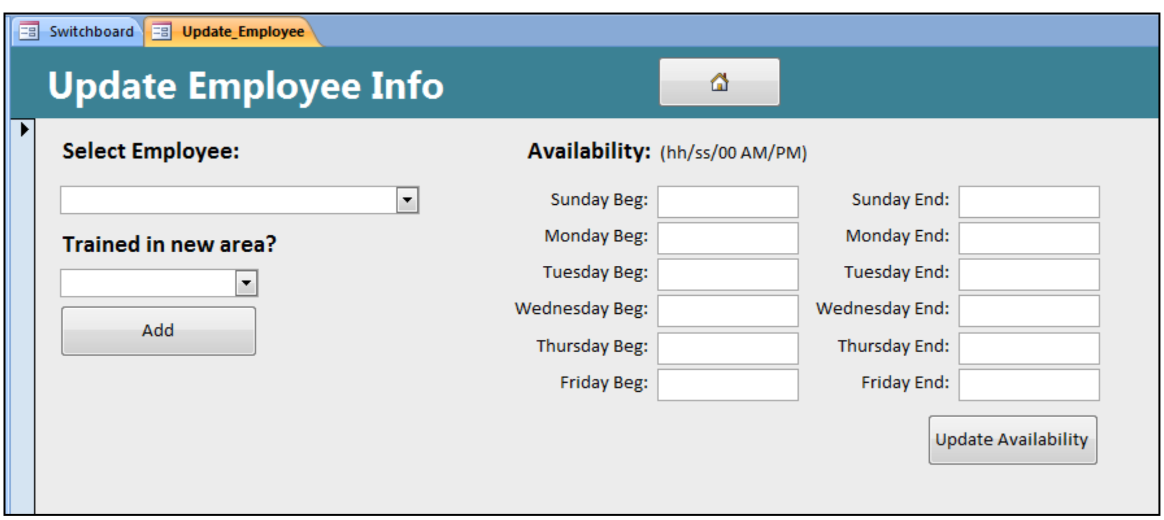
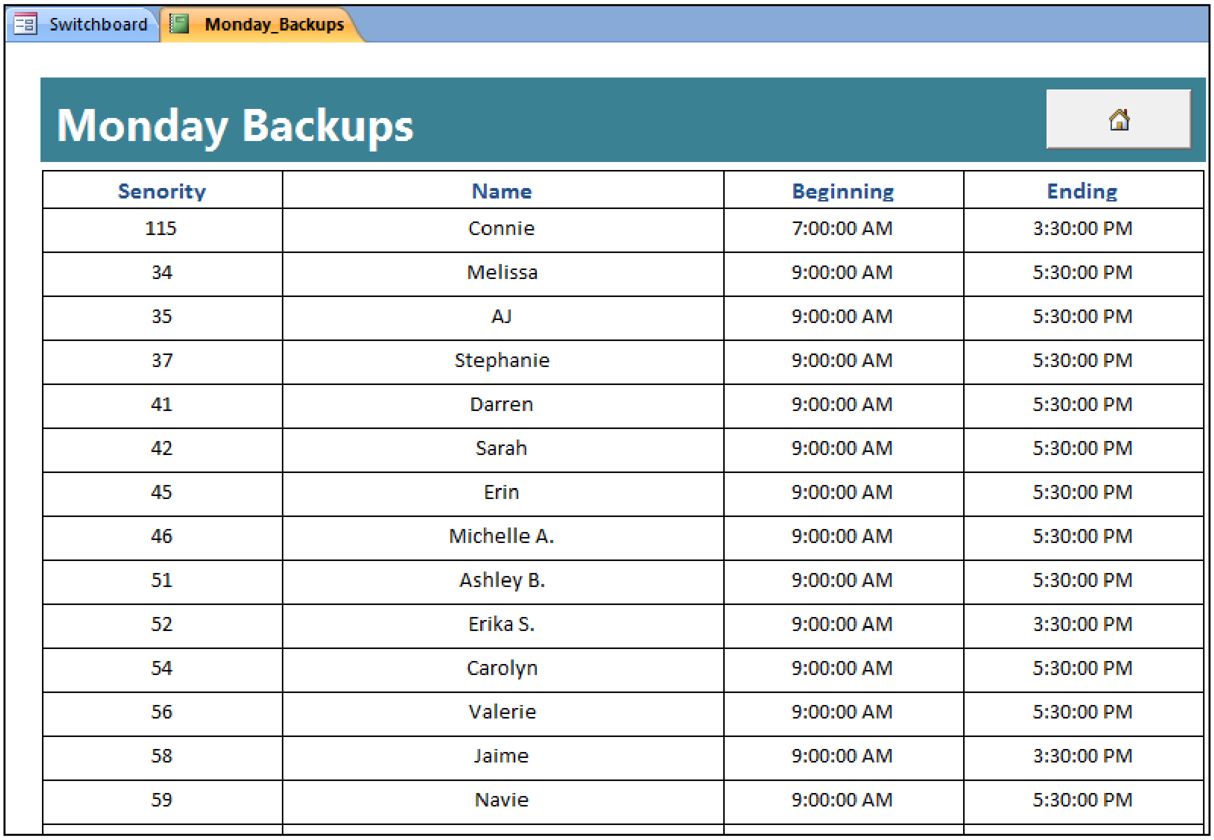



Figure 21: Update employee information form.

## Search for back-ups

Shown below is an example of a report for Monday which shows employees who are not scheduled for that day and their respective availabilities.




| Senority | Name | Beginning | Ending |
|---|---|---|---|
| 115 | Connie | 7:00:00 AM | 3:30:00 PM |
| 34 | Melissa | 9:00:00 AM | 5:30:00 PM |
| 35 | AJ | 9:00:00 AM | 5:30:00 PM |
| 37 | Stephanie | 9:00:00 AM | 5:30:00 PM |
| 41 | Darren | 9:00:00 AM | 5:30:00 PM |
| 42 | Sarah | 9:00:00 AM | 5:30:00 PM |
| 45 | Erin | 9:00:00 AM | 5:30:00 PM |
| 46 | Michelle A. | 9:00:00 AM | 5:30:00 PM |
| 51 | Ashley B. | 9:00:00 AM | 5:30:00 PM |
| 52 | Erika S. | 9:00:00 AM | 3:30:00 PM |
| 54 | Carolyn | 9:00:00 AM | 5:30:00 PM |
| 56 | Valerie | 9:00:00 AM | 5:30:00 PM |
| 58 | Jaime | 9:00:00 AM | 3:30:00 PM |
| 59 | Navie | 9:00:00 AM | 5:30:00 PM |

Figure 22: An example of a Backups form, where the supervisors can view who is available to work, but not on the schedule.

## Coding

VBA coding was required for the drop-down boxes and history buttons. Below is the code we input for the Monday morning shift:

```
' --------------------------------------------------------------------------------------------------------------------------------------
   'Morning Shift
' --------------------------------------------------------------------------------------------------------------------------------------

Private Sub Department1_AfterUpdate()
Me.Positions1.Value = ""
Me.Name1.Value = ""
Me.Form.Refresh
End Sub

Private Sub Positions1_AfterUpdate()
Me.Name1.Value = ""
Me.Form.Refresh
End Sub

Private Sub Name1_AfterUpdate()
Me.Form.Refresh
End Sub

'------------------------------------------------------------
' M_Assign1_Click
'
'------------------------------------------------------------
Private Sub M_Assign1_Click()
On Error GoTo M_Assign1_Click_Err

   Dim Confirm As Integer

   Confirm = MsgBox(Me.Name1.Value & " is about to be added to " & Me.Positions1.Value & " for the Morning shift
on Monday.  Do you want to continue?", vbYesNo, "CONFIRMATION")

   If Confirm = vbYes Then

   DoCmd.OpenQuery "Update_Mon_Morning", acViewNormal, acEdit
   MsgBox (Me.Name1.Value & " has been added to " & Me.Positions1.Value & " for the Morning shift on Monday.")

   Me.Positions1.Value = ""
   Me.Name1.Value = ""

   End If

   Me.Form.Refresh

M_Assign1_Click_Exit:
   Exit Sub
M_Assign1_Click_Err:
   MsgBox Error$
   Resume M_Assign1_Click_Exit

End Sub
```

```
Private Sub History1_Click()

Me.Text_Sun.Value = DLookup("Position", "Sunday", "[Employee] = [Forms]![Monday]![Name1]")

Me.Text_Tues_Morning.Value = DLookup("Position", "Tuesday", "[Morning] = [Forms]![Monday]![Name1]")
Me.Text_Tues_Afternoon.Value = DLookup("Position", "Tuesday", "[Afternoon] = [Forms]![Monday]![Name1]")
Me.Text_Tues_Night.Value = DLookup("Position", "Tuesday", "[Night] = [Forms]![Monday]![Name1]")

Me.Text_Wed_Morning.Value = DLookup("Position", "Wednesday", "[Morning] = [Forms]![Monday]![Name1]")
Me.Text_Wed_Afternoon.Value = DLookup("Position", "Wednesday", "[Afternoon] = [Forms]![Monday]![Name1]")
Me.Text_Wed_Night.Value = DLookup("Position", "Wednesday", "[Night] = [Forms]![Monday]![Name1]")

Me.Text_Thurs_Morning.Value = DLookup("Position", "Thursday", "[Morning] = [Forms]![Monday]![Name1]")
Me.Text_Thurs_Afternoon.Value = DLookup("Position", "Thursday", "[Afternoon] = [Forms]![Monday]![Name1]")
Me.Text_Thurs_Night.Value = DLookup("Position", "Thursday", "[Night] = [Forms]![Monday]![Name1]")

Me.Text_Fri_Morning.Value = DLookup("Position", "Friday", "[Morning] = [Forms]![Monday]![Name1]")
Me.Text_Fri_Afternoon.Value = DLookup("Position", "Friday", "[Afternoon] = [Forms]![Monday]![Name1]")
Me.Text_Fri_Night.Value = DLookup("Position", "Friday", "[Night] = [Forms]![Monday]![Name1]")
End Sub
```

This section of code was repeated for every shift of every day with the appropriate parameters regarding textbox names changed. Under “Morning Shift,” each of those lines refreshes the combo boxes after every assignment. The entries that were previously in the “position” and “name” box disappear after a new department has been selected. Also, the queries linked to the combo boxes refresh every time. Under “M_Assign1_Click,” the code runs the update query that logs the action into a history table. It also brings in the confirmation box and message box after the “assign” button has been clicked. The code underneath “Private Sub History1_Click” is a string of “D-lookups” that pull information from tables and inserts it into textboxes. Positions of the name selected are taken from each shift of the previous five days in the history tables for those days and inserted into the textboxes on the form.

## Methods

Our earliest experimentation for this project took place during our second facility visit. We wanted to gauge how successful our suggestions would be by conducting time studies of an operator and controlling two variables. The database we created also involved much extensive testing to ensure all bugs were wiped out.

# Design of Experiment – Ergonomics of workbenches

## Background

In conducting our analysis of the ergonomics of Kaiser's workstations, we came across a dilemma. Although there are standardized human factors heuristics for table height and body position, the issue arises of whether new changes to the stations could actually become a detriment to the employees. The functions in the packing area are highly repetitive, and many of the packers have been working at the facility for several years. After becoming accustomed to performing a series of physical tasks every day, a muscle memory forms and the packers become very used to the same motions. A change in the design of the work station would require the packers to break out of this habitual mold, which may be very challenging for them.

During one of our visits to the facility, we designed an experiment using Steven, one of Kaiser's most experienced packers, as our participant. The purpose of this experiment was to determine if the conditions of sitting vs. standing and table height have any effect on the performance of the packers. The factors were position and table height and our response variable was the time it took for him to complete one packing cycle. As we conducted the time study, we sought to discover if any combination of conditions deviated from all the treatments. What we hope to prove is that the set of conditions that align with our ergonomic suggestions either exceeds or is equal to performance compared to the rest. We rate performance by the average time for our replications, the lowest times indicating the best

## Experimental Design

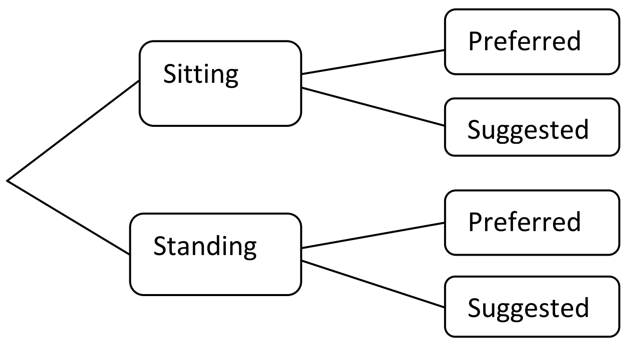
In conducting this experiment, we used one of Kaiser's packers and one of their workstations, which includes the following items:

In our time study, we began the stopwatch when Steven scanned his first item. He would then go on to grab the verification documents from the printer, scan them, fold them in half and open the bag, stick the papers in, grab the shipping labels from the label printer, stick the label on the bag, tear

the bag away from the dispenser, heat seal the bag, and toss the bag onto the conveyor for shipment. We ended the watch when the package was sealed. Each treatment condition was repeated ten times to achieve greater consistency.

The response variable is the time in seconds that it took for him to perform one packing cycle. For each of the factors, there were two levels. For position, the levels were sitting vs. standing; and for table height, the levels were packer's preference vs. our suggestion (1 inch below the elbow). Having two factors at three levels, this equaled four treatments. The graphical representation is shown below:

### Tree representation of Treatments: Follow each branch




## DOE Results

The summarized results are shown below in Table 1 for each factor. The complete dataset is shown in Appendix A, Table 10. Outliers over thirty seconds were thrown out. The cycle took longer whenever there was a large package, or one that needed special instructions. The number of replications we conducted (ten) was not enough to normalize these special circumstances within each treatment, so the outliers were disregarded because results would be skewed.

Table 1: Time study averages for each factor.

| Position | Table Height | Time (Sec.) |
|---|---|---|
| Sitting | Preferred | 20.29 |
| Standing | Preferred | 20.02 |
| Sitting | Suggested | 18.40 |
| Standing | Suggested | 19.07 |
| Average | | 19.44 |

### Surface Response

Below are two simple bar graphs of raw data, shown in Table 2 & 3. The first shows every data point we took that will be taken into consideration. The bottom graph shows the averages of each treatment. The x-axis contains each treatment condition, and the Y-axis is time for each cycle, so the lower bars mean better performance.

Table 2: Data from a time study to compare the cycle times for packing prescriptions to different conditions.

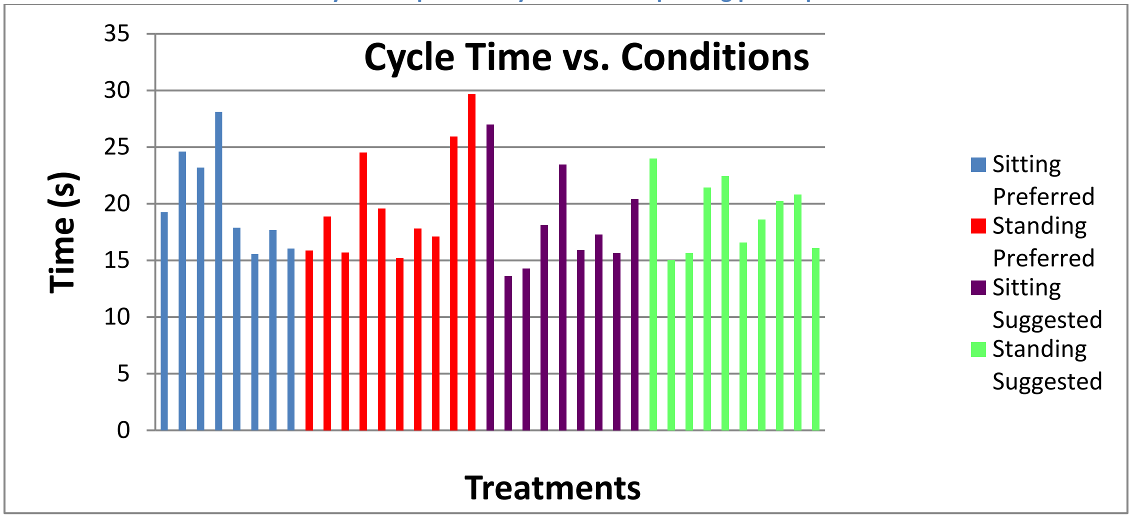
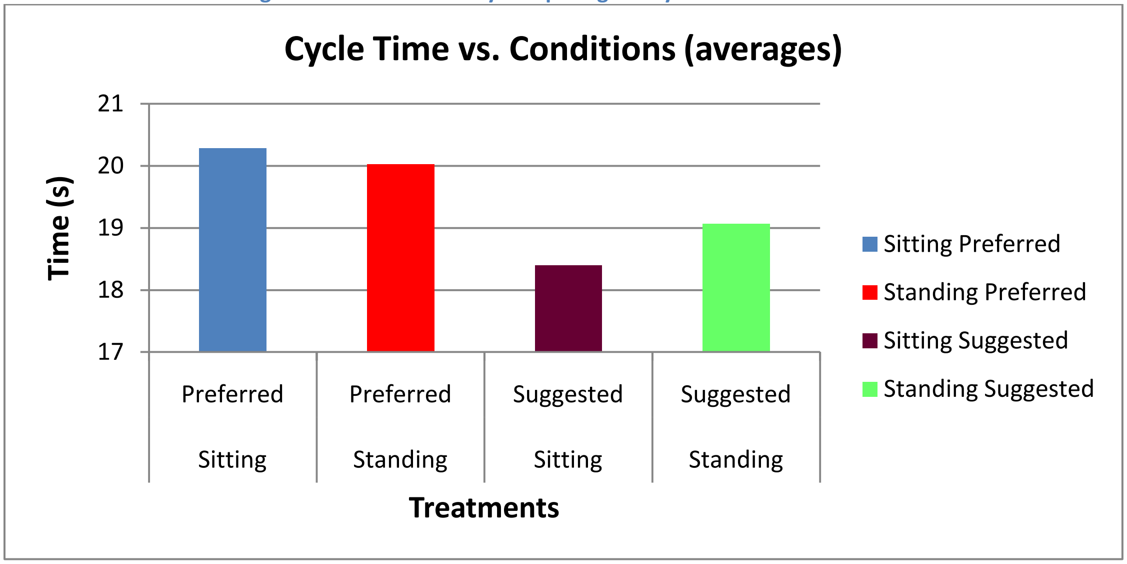



Table 3: Averages from the time study comparing the cycle times to different condiditons.



## ANOVA Hypothesis & Results

Since this experiment has multiple factors and combinations, analysis of variance is necessary.

We tested the null hypothesis as follows:

Ho: $\alpha_1 = \alpha_2$

$\beta_1 = \beta_2$

Where α is the effect of position and β is the effect of table height on cycle time. The null hypothesis states that our suggested conditions will not have an effect on performance.

The alternative hypothesis, which we sought to disprove, is as follows:

$H_1$: $\alpha_1 < \alpha_2$

$\beta_1 < \beta_2$

This states that suggested conditions will have greater cycle times than the normal circumstances and therefore will either have a negative effect on performance.

Minitab generated the following ANOVA results in Table 4:

Table 4: ANOVA results from the time study.

| Source | DF | Seq SS | Adj SS | Adj MS | F | P |
|---|---|---|---|---|---|---|
| **Position** | 1 | 0.622 | 0.385 | 0.3848 | 0.02 | 0.886 |
| **Table Height** | 1 | 17.572 | 18.444 | 18.4441 | 1.00 | 0.326 |
| **Interaction** | 1 | 2.001 | 2.001 | 2.0009 | 0.11 | 0.744 |
| **Error** | 33 | 611.086 | 611.086 | 18.5178 | | |
| **Total** | 36 | 631.282 | | | | |

In order to determine whether each factor has a statistically significant effect on the outcome or response, we look at every p-value. As it turns out, both factors as well a possible interaction effect had high p-values. I decided to set the significance level at 5% and each p-value was well above that threshold. Position had a very high p-value of 88.6% and table height also exceeded the significance

level at 32.6%. Since both p-values are high, this means those two conditions do not have a statistically significant effect on the outcome and therefore we do not reject the null hypothesis. By examining the F-statistic, we can determine the order of the ingredients' significance. Since the F statistic is always right tailed, a higher value implies stronger evidence that the factors have a large effect. As you can see from the table, both position and table height have very low F values of .02 and 1.0 respectively. This is not surprising to me as the results showed that there was hardly a difference in the averages for each treatment.

### DOE Conclusions & Recommendations

Ideally, we would have liked to have proved that our suggested conditions of Standing & Preferred table height resulted in the best performance at a statistically significant level. However, it is not surprising that these recommendations did not yield the fastest time since the operators are very used to packing with their own preferred style, and we did force them to step out of this comfort zone. However, what we did prove turned out to be very valuable. Research has shown that our recommendations are in fact the optimal ergonomic conditions in order to reduce strain and prevent injury that accumulates over a period of time. Before suggesting these conditions, we had to prove that they did not lessen performance and productivity. After analyzing our ANOVA results, we can support the assertion that our new measures should be adopted, because they are ergonomically better and they will *not* be detrimental to performance due to comfort level.

## Database Testing

Quite possibly the most time consuming aspect of building a database is all of the testing and debugging associated with ensuring that the final product will actually work and meet all of our initial specifications. There are many things that can go wrong such as mistyping a word in the code or referencing the wrong query. We challenged the database extensively to ensure that all of our errors were caught and fixed.

## Employee Schedules and Availability

The accuracy of the assistants' scheduling information was pivotal since our entire database is centered on capturing the workers' availabilities in order to assign them to a station. After one partner manually input all 113 assistant availabilities, the other partner printed off the sheet and double-checked that everything was correct. Additionally, the employee schedule would be a reduced version of the entire availability. When the assignment process begins, all of the queries take information from the schedule. We made sure that any employee's name that appeared in the drop-down box fit the actual schedule.

## Queries

Our database consisted of a whopping 130 queries. A bug in any one of these would have compromised the integrity of our database.

### *Update queries*

Every time an employee is assigned to a station, their name is recorded to a history table. This feature was done through a query which would "update" the respective table. If this query fails, it would defeat the entire purpose of our database. To test these queries, we randomly assigned workers on every single shift on every single day. After each assignment, we opened the respective history table to see that the person's name was actually recorded.

Our other update query concerned the instance when an employee needed to change his or her availability. We have a form which allows the supervisor to do this. To test the functionality, we added fictional names and times to our availability table (so we don't change the information of actual employees) and then updated the information. If the table updated, our query was working.

### *Department-workstation queries*

A useful feature of our database was the ability of specific workstations (packing 1, packing 2...etc) to be linked to departments (packing). In our system, after a department was selected from a drop-down box, the respective positions within that department would be included in the subsequent drop-down box. To test this, we selected every department from each shift on each day, and pulled down the position drop-down to make the positions matched with the department.

### *Name Query*

The drop-down box which provided the names of available employees based upon the position they were qualified for is an extremely important feature. It eliminates the need for tribal knowledge and the hunt-and-pecking associated with looking at 113 names. To test this query we made sure the names that appeared in this drop-down box matched both those employees' availabilities and their specialties, both of which are logged in our database.

### *Set-Difference Queries*

In terms of user-friendliness, one of the best features of our database is the ability of an employee's name to disappear from the employee drop-down box after he or she has been assigned. The supervisor can easily continue the assignment process without having to cross out any names. We accomplished this through a series of set-difference queries which would only pull up names of those who were not in the history table. To test this, after randomly assigning employees, we pulled up the drop-down box to see if his or her name was still there.

Our next set-difference query would allow supervisors to search for back-ups if there was a shortage or if someone called off. We ran each these queries for each day after loading the history table with certain names. We knew the queries we working when the names of all those we did not load in the tables appeared.

### *Append and Delete Queries*

If a new employee was hired or an old employee left the company, we would need to add or delete their names and information from our tables. This was done through append and delete queries which ran on two forms. To test this, we added fictional names and made sure that name showed up on the new tables. We then deleted these names and made sure their information was not in the table anymore.

### *Make-Table Queries*

Upon advancement of each page from Sunday to Friday, a make-table query runs, which refreshes the history table of the next day. The names will be emptied, but the positions will remain. To test this, we advanced throughout each day and checked the respective table to ensure that all names have been deleted.

### Employee History Lookups

Another issue of Kaiser's that our database hopes to reconcile is the lack of rotation of employees throughout the week. We created empty text boxes that correspond to all shifts from the previous five days and when a "see history" button was clicked, the positions of a selected employee would appear in each of these boxes. The point of this is for the supervisor to see, at his or her own discretion, if any employee needs to be rotated more frequently. To test this "D-lookup" code, we entered an arbitrary name (Jimmie) in every single history table and every single shift. We advanced through all of the pages and clicked every "see history" button. If text appeared in every box when Jimmie's name was entered, we were successful.

### Final Run-Through

Our final overall test was going through the entire process ourselves as if we were the scheduling supervisors. Small checks were made along the way analogous to a sampling procedure. As of now, we are confident in handing over the database to Kaiser.

## Results – Ergonomics of Workstations

Our approximation of the results upon implementation has been analyzed with a Methods-Time Measurement (MTM) study. This is the closest estimate we can make without measuring the actual implementation. Table 5 on the next page is a MTM table for the current conditions of packing. Table 6 on the next page is a MTM of the conditions for our new design.

## Original MTM Table

Table 5: MTM analysis on a current workstation with the conveyor belt to the left.

| MTM Analysis | | | | | | |
|---|---|---|---|---|---|---|
| Current Workstation with conveyor belt to the left side of the worker | | | | | | |
| Left Hand Activity | Dup | LH Symbol | TMU | RH Symbol | Dup | Righ Hand Activity |
| Turn torso 90° left | | T | | T | | Turn torso 90° left |
| Reach for tote | | RB | | | | |
| Grasp tote | | G1A | | | | |
| Move tote off conveyor to tote staging area | | MC | | | | |
| Release Tote | | RL1 | | | | |
| Reach for Rx | | RC | | | | |
| Grasp Rx | | G1B | | | | |
| Turn torso back 90° | | T | | T | | Turn torso back 90° |
| Move Rx to barcode scanner | | MB | | | | |
| | | | | RA | | Reach for package |
| | | | | G3 | | Grasp package to open package |
| Move Rx to package | | MB | | | | |
| Release Rx into package | | RL1 | | RL1 | | Release package |
| Reach for Shipping Label | | RA | | | | |
| Grasp Shipping Label | | G1A | | | | |
| Move Shipping Label to package | | MB | | | | |
| | | | | G1A | | Grasp Shipping Label |
| Position Shipping Label onto package | | P2 | | P2 | | Position Shipping Lable onto package |
| Release Shipping Label & package | | RL1 | | RL1 | | Release Shipping Label & package |
| Turn torso 90° right | | T | | T | | Turn torso 90° right |
| | | | | RL1 | | Reach for Rx Verification Docs at printer |
| | | | | G1A | | Grasp Rx Verification Docs |
| | | | | MB | | Move Rx Verification Docs to barcode scanner |
| | | | | MB | | Move Rx Verification Docs in front of package |
| Reach for Rx Verification Docs | | RA | | | | |
| Grasp Rx Verification Docs | | G1A | | | | |
| Fold Rx Verification Docs in half | | D | | D | | Fold Rx Verification Docs in half |
| Move Rx Verification Docs to package | | MB | | MB | | Move Rx Verification Docs to package |
| Release Rx Verification Docs into package | | RL1 | | RL1 | | Release Rx Verification Docs into package |
| | | | | R | | Reach for KP insert |
| | | | | G1A | | Grasp KP insert |
| | | | | MB | | Move KP insert to package |
| | | | | RL1 | | Release KP insert into package |
| Turn hand 90° | | T | | T | | Turn hand 90° |
| Reach for package | | RA | | RA | | Reach for package |
| Grasp package | | G3 | | G3 | | Grasp package |
| Tear off package from PaceSetter | | AP | | AP | | Tear off package from PaceSetter |
| Move package to heatsealer | | MB | | MB | | Move package to heatsealer |
| Position package on heatsealer | | P1 | | P1 | | Position package on heatsealer |
| Release package | | RL2 | | | | |
| Press heatsealer trigger | | AP | | | | |
| Release heatsealer trigger | | RL2 | | | | |
| Grasp sealed package | | G2 | | G2 | | Grasp sealed package (Hand already on package) |
| Move sealed package to barcode scanner | | MB | | MB | | Move sealed package to barcode scanner |
| | | | | RL1 | | Release sealed package |
| Turn torso 30° left | | T | | | | |
| Release sealed package (by tossing onto conveyor) | | RL1 | | | | |
| Turn torso back 30° facing PaceSetter | | T | | | | |
| Cycle Time | | | 19.44 | Seconds | | |

## New MTM Table with Redesign

Table 6: MTM analysis on the new workstation design in which the employee will pick totes from the left.

| MTM Analysis | | | | | | |
|---|---|---|---|---|---|---|
| New Workstation Design with work picking totes from the left side | | | | | | |
| **Left Hand Activity** | **Dup** | **LH Symbol** | **TMU** | **RH Symbol** | **Dup** | **Righ Hand Activity** |
| Reach for tote | | RB | | | | |
| Grasp tote | | G1A | | | | |
| Move tote off conveyor to tote staging area | | MC | | | | |
| Release Tote | | RL1 | | | | |
| Reach for Rx | | RC | | | | |
| Grasp Rx | | G1B | | | | |
| Move Rx to barcode scanner | | MB | | | | |
| | | | | RA | | Reach for package |
| | | | | G3 | | Grasp package to open package |
| Move Rx to package | | MB | | | | |
| Release Rx into package | | RL1 | | RL1 | | Release package |
| | | | | RA | | Reach for Shipping Label |
| | | | | G1A | | Grasp Shipping Label |
| | | | | MB | | Move Shipping Label to package |
| Grasp Shipping Label | | G1A | | | | |
| Position Shipping Label onto package | | P2 | | P2 | | Position Shipping Lable onto package |
| Release Shipping Label & package | | RL1 | | RL1 | | Release Shipping Label & package |
| Reach for Rx Verification Docs at printer | | RL1 | | | | |
| Grasp Rx Verification Docs | | G1A | | | | |
| Move Rx Verification Docs to barcode scanner | | MB | | | | |
| Move Rx Verification Docs in front of package | | MB | | | | |
| | | | | RA | | Reach for Rx Verification Docs |
| | | | | G1A | | Grasp Rx Verification Docs |
| Fold Rx Verification Docs in half | | D | | D | | Fold Rx Verification Docs in half |
| Move Rx Verification Docs to package | | MB | | MB | | Move Rx Verification Docs to package |
| Release Rx Verification Docs into package | | RL1 | | RL1 | | Release Rx Verification Docs into package |
| | | | | R | | Reach for KP insert |
| | | | | G1A | | Grasp KP insert |
| | | | | MB | | Move KP insert to package |
| | | | | RL1 | | Release KP insert into package |
| Turn hand 90° | | T | | T | | Turn hand 90° |
| Reach for package | | RA | | RA | | Reach for package |
| Grasp package | | G3 | | G3 | | Grasp package |
| Tear off package from PaceSetter | | AP | | AP | | Tear off package from PaceSetter |
| Move package to heatsealer | | MB | | MB | | Move package to heatsealer |
| Position package on heatsealer | | P1 | | P1 | | Position package on heatsealer |
| Release package | | RL2 | | | | |
| Press heatsealer trigger | | AP | | | | |
| Release heatsealer trigger | | RL2 | | | | |
| Grasp sealed package | | G2 | | G2 | | Grasp sealed package (Hand already on package) |
| Move sealed package to barcode scanner | | MB | | MB | | Move sealed package to barcode scanner |
| | | | | RL1 | | Release sealed package |
| Cycle Time | | | | Seconds | | |

Our new design eliminates two significant motions that have contributed to injury and strain: twisting the torso and neck in the direction of the conveyor, and using the elbow to toss the package. The following steps from the MTM of original conditions will be removed with our new design: The During our second facility visit, we conducted time studies of an operator for our DOE analysis. Using the data we obtained, we computed an average of 19.44 seconds for one cycle of packing. This was taken from 37 measurements. Within an eight hour shift, approximately 1440 cycles would occur. During each cycle, three torso/neck twist and one elbow extension occurs. With our new design, 4320 torso/neck motions and 1440 elbow movements would be eliminated in just one eight hour shift.

## Cost Analysis

We performed a cost analysis of all materials suggested as well as the labor associated with implementation. There are two separate analysis outlined—one for total implementation of our redesign and one for the minimum of our suggestions. Minimal adjustments refer to the addition of a computer monitor arm, keyboard tray, and foot mat. We included this analysis so that Kaiser may have an inexpensive alternative to consider in case they decide that our complete redesign is too costly. Tables 7 and 8 below outline the implementation costs for both alternatives.

Table 7: Estimated cost to implement the new workstation design on the tote packing line.

| Implemenation Cost for New Workstation | | | | |
|---|---|---|---|---|
| **Position** | **# of Employees** | **Labor Cost ($/hour)** | **Estimated Hours** | **Total** |
| **Manual Labor** | 15 | 27 | 16 | $6,480.00 |
| **Supervisors** | 2 | 60 | 16 | $1,920.00 |
| **IT Support** | 2 | 37.5 | 16 | $1,200.00 |
| | | | | **$9,600.00** |

Table 8: Estimated cost to implement the minimal adjustments for the current workstations.

| Implementation Cost for Minimal Adjustments | | | | |
|---|---|---|---|---|
| **Position** | **# of Employees** | **Labor Cost ($/hour)** | **Estimated Hours** | **Total** |
| **IT Support** | 2 | 25 | 16 | $ 800.00 |
| **Manual Labor** | 2 | 18 | 16 | $ 576.00 |
| | | | | **$ 1,376.00** |

We decided on a span of 16 hours for implementation. Our suggestion to Kaiser will be to complete the changeover during two Saturdays. On the first Saturday, only half of the workstations will be replaced. This will give the employees one week to "test out" the new tables and give any useful feedback so that their suggestions may be taken into consideration. On the second Saturday, all of the workstations will be replaced. Table 9 below outlines the cost for the materials as well as implementation for both alternatives. The columns on the left are the total costs for one workstation, and the columns on the right are the costs for all 27 workstations.

Table 9: Cost Analysis for the minimal adjustments and new workstation design.

| Cost Items | One Workstation | | All Tote Packing Workstations | |
|---|---|---|---|---|
| | Minimal Cost | Maximum Cost | Minimal Cost | Maximum Cost |
| **Custom Workstation** | $ - | $ 500.00 | $ - | $ 500.00 |
| **Rx Package Slide** | $ - | $ 100.00 | $ - | $ 100.00 |
| | | | | |
| **Computer Monitor Arm** | $ 245.00 | $ 245.00 | $ 6,615.00 | $ 6,615.00 |
| **Keyboard Tray/Drawer** | $ 65.00 | $ 65.00 | $ 1,755.00 | $ 1,755.00 |
| **Foot Mat** | $ 45.00 | $ 45.00 | $ 1,215.00 | $ 1,215.00 |
| | | | | |
| **Implementation** | $ 50.96 | $ 355.56 | $ 1,376.00 | $ 9,600.00 |
| | | | | |
| **Total** | **$ 405.96** | **$ 1,310.56** | **$ 10,961.00** | **$ 19,785.00** |

The total cost of our redesign comes out to be $1,310 for one workstation and $19,785 for all workstations. Kaiser will have to weigh the benefits of reduced employee strain/injury over a long period of time against the cost of workbench replacement.

## Results – Assistant Database

After thorough planning, design, and testing, we created a dynamic database that will streamline the schedule/assignment process. The second design we made held all the way to the end of our project. Because reworking a database is extremely time-consuming, we made sure in the beginning that all of our objectives could be met with our final design. In the end, the quality, functionality, and usability of our database matched our initial expectations. The only thing that was off-track was our productivity estimates. We had not imagined all of the work and obstacles that would surface in this project. Fortunately, the hindrances we have faced are now all reconciled and our final product has met every single goal we outlined in the design section.

### Benefits

The use of queries eliminates the need to manually write and type in names. It also significantly reduces the "hunt-and-pecking" associated with searching for those who can work at certain times or those qualified for certain positions. A side-by-side comparison of template and schedule is no longer necessary. When we spoke to Kim about the scheduling/assigning process, she mentioned that the process consumed about 7-8 hours. Since the facility computers do not have Microsoft Access, we haven't been able to test our database with the supervisors. However, we are confident that our program would dramatically reduce the time spent during this process. If Kaiser implements our program, we will conduct a follow-up to gauge an approximation of time saved.

Aside from time reduction, we have increased the value of the medium through which scheduling/assigning is done by developing new features. The query which links positions to departments is especially useful when new supervisors come in. Currently, there is only "tribal knowledge" as to who can do what. When a new supervisor comes in, that information will already be built into the system. The ability to instantly see an employee's position history for the past week is another feature we thought up when Kim noted that employees would frequently complain about not

being rotated enough.  Our program will facilitate the scheduler's discretion by allowing him or her to see if an employee has been working the same function several days in a row.   This would be an immediate signal to begin assigning that worker to another function, increasing employee satisfaction. Our last feature is the capability of a list that allows supervisors to see all who are available for backup. This will resolve the difficulty of finding replacements when there is a staff shortage, a pressing scheduling problem specifically mentioned by Kaiser Management during our visits.

Below is our initial list of objectives and how each of them has been met:

- Eliminate the need for a schedule/assignment side-by-side comparison. The queries pull from the schedule, thus eliminating the need to compare the template to the schedule.
- Allow for the positions and employees that have already been assigned to "disappear" from the remaining list. Our set-difference queries eliminate previously assigned names from the drop-down box.
- Allow for new employees to be added or current employees to be deleted from the record. Our "Add Employee" and "Delete Employee" forms allow supervisors to add or remove assistants from the schedule.
- Allow for information to be updated with as much or more ease than updating on Excel.  The "Update Employee Info" form simply involves selecting an employee name and changing their information.  All the updating is done on one page.
- Create a feature which will assist with position rotation throughout the week.  Our "history" textboxes allow the supervisor to view positions from the past 5 days of a selected employee.
- Create a feature that would allow supervisors to easily search for back-ups.  We have created back-up forms for each day of the week that take approximately 2 seconds to load.

## Limitations

One the biggest concern of the supervisor we collaborated with was the staff's lack of familiarity with Microsoft Access. With that consideration in mind, our goal was to make every input as user-friendly and self-explanatory as possible. Anything we could think of that the scheduling/assigning process involved is accessible on a form from the switchboard. Absolutely no coding and creation of tables/queries is necessary on their part. However, in the case of a major change in the process (new shifts, different workstations, new positions...etc.), Kaiser will have to contact us to figure out how to make these changes within the database.

Furthermore, Access is not a perfect program and it has its inherent flaws. On occasion, the queries linked to the drop-down boxes will take longer to process, resulting in the drop-down being empty. If this happens, the supervisor will have to either wait a minute or close out the form and re-open it from the switchboard. Although this is not difficult to do, it is bothersome and somewhat confusing when nothing appears in a drop-down.

Kaiser does not currently possess Microsoft Access on their computers. The cost of one package for the 2010 version is $139.99 and $107 for 2007. These prices were obtained from Microsoft's website. We will be recommending the 2007 version, because it will be more compatible with the facility's current package. After viewing our presentation, the supervisors must weigh the benefits, many of which are qualitative, against the cost.

## Conclusion

Upon observing several processes and operations of Kaiser Permanente's facility in Downey, two areas caught our attention as issues we could use our talents and background to creatively resolve. While observing the packing operations, the cluttered and disorganized appearance of the workstations was the first thing we noticed. After speaking to Alex, he informed us that one of the packing area's largest concerns was the design of the workbenches and the amount of injury/strain caused by the repetitive motion of the job functions. As we continued our tour, we spoke briefly to the other supervisors about their scheduling procedures. Kim mentioned that the assignment process in particular was done in a time-consuming and inefficient manner.

After absorbing all the information we gleaned from both facility visits, we decided that our background in Human Factors and Database Programming would be conducive to improving redesigning workstations and streamlining the assignment process with a database system. We designed a more ergonomic, space-efficient, and automated workstation which reduces eye strain and eliminates a troublesome throwing motion. We also created a dynamic database that utilizes queries to significantly diminish the time spent matching available people to specific stations. In the process, we built in the ability to view an employee's weekly history and the capability of quickly searching for backups.

As surprised as we were to learn about the large inefficiencies that such an advanced company was experiencing, we were just as excited to apply our education and experiences to developing solutions. If our suggestions are implemented, we foresee great benefits to the company with regards to physical employee strain as well as the mental strain of a currently tedious assignment process. In the application of Industrial Engineering concepts to a company in industry, we learned about the important of planning and collaboration, the limitations and intricacies of a novel design, and the resourcefulness required to produce a realistic and fully functional end result.

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# Appendix A – DOE Dataset

Table 10: Dataset from time study on packing cycle time.

| Position | Table Height | Time (Sec.) |
|---|---|---|
| Sitting | Preferred | 19.26 |
| Sitting | Preferred | 24.59 |
| Sitting | Preferred | 23.19 |
| Sitting | Preferred | 28.1 |
| Sitting | Preferred | 17.88 |
| Sitting | Preferred | 15.57 |
| Sitting | Preferred | 17.67 |
| Sitting | Preferred | 16.03 |
| Standing | Preferred | 15.85 |
| Standing | Preferred | 18.86 |
| Standing | Preferred | 15.71 |
| Standing | Preferred | 24.52 |
| Standing | Preferred | 19.56 |
| Standing | Preferred | 15.23 |
| Standing | Preferred | 17.81 |
| Standing | Preferred | 17.11 |
| Standing | Preferred | 25.91 |
| Standing | Preferred | 29.68 |
| Sitting | Suggested | 26.96 |
| Sitting | Suggested | 13.62 |
| Sitting | Suggested | 14.25 |
| Sitting | Suggested | 18.09 |
| Sitting | Suggested | 23.47 |
| Sitting | Suggested | 15.93 |
| Sitting | Suggested | 17.25 |
| Sitting | Suggested | 15.65 |
| Sitting | Suggested | 20.39 |
| Standing | Suggested | 23.97 |
| Standing | Suggested | 15.02 |
| Standing | Suggested | 15.64 |
| Standing | Suggested | 21.4 |
| Standing | Suggested | 22.42 |
| Standing | Suggested | 16.56 |
| Standing | Suggested | 18.59 |
| Standing | Suggested | 20.26 |
| Standing | Suggested | 20.81 |
| Standing | Suggested | 16.06 |

## Appendix B – Project Management Plan

This report is the result of a two-quarter long project. Because this project is a partnership, it is pivotal that we create an effective project management plan so that both partners can be on the same page with all of our duties and responsibilities. Included in our plan is a statement of work with a timeline, a responsibility matrix, and a communication plan.

### *Statement of Work*

We have developed a statement of work that outlines our entire process and everything we wish to achieve.

#### Purpose/mission statement:

To improve the ergonomic design of Kaiser Permanente's workstations and enhance their production control system.

#### Scope Statement:

Develop a workstation redesign that will reduce long term employee strain and injury. Enhance the current scheduling/assignment system by creating supplementary system that will be more user-friendly and streamline the assignment process. Implementations include replacement of current workbenches with our new design and the utilization of our assignment database.

#### Deliverables:

- Re-design the workbenches to allow for optimal user-friendliness
- Reduce the number of injuries per year with our new design
- Initiate improved scheduling system that reduces time and error

## Schedule Estimates:

- The entire project must be completed by March 16th, 2010.
- Status reports will also be made upon Kaiser's request, our own discretion, and per the due dates of IME 481/482.
- We will meet once a week and discuss our respective assignments.
- We will report to and make contact with Kaiser Permanente and Liz approximately once every two weeks and as needed to make sure our ideas are plausible.

**Time Estimates and Milestones:** Planned vs. Actual

**Planned**

**11/1/2010:** Visit the facility

**11/2/2010:** Narrow problem areas and analysis tools

**11/17/2010:** Turn in Literature Review

**11/23/2010:** Turn in Introduction & background

**11/30/2010:** Turn in first two chapters and plan to complete project

**12/14/2010:** Second facility visit

**12/14/2010:** Create detailed project management plan centered around mission statement

**1/26/2011:** Finish conducting data gathering, analysis, design…etc

**2/8/2011:** Begin rough draft of proposal

**2/10/2011:** Completion of prototype model of redesigned workstation

**2/11/2011:** Peer edit and finalize proposal

**2/15/2011:** Finish final draft and begin building presentation

**2/28/2011:** Practice presentation

**March TBA:** Present

See Gantt Chart for visual representation

**Actual – Deviations are colored in red**

**11/1/2010:** Visit the facility

**11/17/2010:** Turn in Literature Review

**11/23/2010:** Turn in Introduction & background

**11/30/2010:** Turn in first two chapters and plan to complete project

**12/14/2010:** Second facility visit

**12/17/2010:** Narrow problem areas and analysis tools

**12/20/2010:** Create detailed project management plan centered around mission statement

**2/10/2011:** Completion of prototype model of redesigned workstation

**2/18/2011:** Begin rough draft of proposal

**2/22/2011:** Finish conducting data gathering, analysis, design…etc

**2/22/2011:** Peer edit and finalize proposal

**2/28/2011:** Finish final draft and begin building presentation

**3/10/2011:** Practice presentation

## Objectives:

- Reduce the number of injuries per year with our new design
- Initiate improved scheduling system that reduces time and error
- Receive approval from Kaiser of possible implementation of our plans

## Stakeholders:

- Connie Chou
- Brett Witherall
- Dr. Liz Schlemer
- Kaiser Permanente management
- Kaiser Permanente staff

## Chain of Command:

Generally, there will be continual communication between both members of the team to hopefully reach a consensus for every task, design, and decision. We will report to Liz with all of our major ideas before we present them to Kaiser. Our point of contact is Steven Kim, Alex Ortiz, and Kim Nakamura. We will contact Alex and Steven with ergonomic matters and Kim with scheduling matters.

## Responsibility Matrix:

Though the both members have continued steady collaboration, we divided some of our tasks. Our responsibilities are outlined below in Table 11, as well as our methods of communication.

**Table 11: Group members' responsibilities throughout the project.**

| Responsibility Matrix | | |
|---|---|---|
| | Connie | Brett |
| Project definition | 1 | 1 |
| Status reports | 1 | 1 |
| Research | 1 | 1 |
| Facility visits/ contacting Kaiser | 1 | 1 |
| Project management plan | 1 | 2,4 |
| Design of Experiment analysis | 1 | 2,4 |
| Workstation redesign rough sketches | 2,3 | 1 |
| Workstation redesign plans | 1 | 1 |
| Workstation final sketches | 2,4 | 1 |
| Scheduling analysis | 1 | 3 |
| Scheduling improvements | 1 | 1 |
| Project report | 1 | 1 |
| Project presentation | 1 | 1 |

| Responsibility Key | |
|---|---|
| 1 | Responsible |
| 2 | Support |
| 3 | Notification |
| 4 | Approval |

## Communication Plan:

Table 12: Communication plan drawn up by group members to help manage project.

| Communication Plan | | | | |
|---|---|---|---|---|
| **What Information** | **Target Audience** | **When?** | **Method of Communication** | **Provider** |
| Status Reports | Liz, Administrative Advisor, Kaiser. | Bi-weekly | E-mail | Connie and Brett |
| Meeting Agenda | Kaiser | During visits & conference calls | E-mail & Hardcopy at meeting | Connie and Brett |
| Mini Milestone Updates | Kaiser | When completed | E-mail | Connie and/or Brett |
| Problem shooting | Connie & Brett | When Needed | E-mail or Phone call | Kaiser |
| Kaiser Consulting | Kaiser | Bi-monthly/ when needed | E-mail | Connie and/or Brett |
| Consulting Professors | Corresponding Professor | When Needed | Office hours | Connie and/or Brett |
| Scope check or ideas touch base | Liz | Anytime | Email or Office hours | Connie and Brett |