

THE PAD CLIMBING ROUTE SETTING PROCESS REDESIGN

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ABSTRACT

The Pad Climbing Route Setting Process Redesign

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This study took place at The Pad Climbing, a rock climbing gym in San Luis Obispo. The problem was that the process of setting new climbing routes was time-consuming and potentially dangerous. This resulted in lower capacity, high labor costs, decreased customer satisfaction, and safety risk for employees and customers. The objective of this study was to analyze the route setting process and identify areas of waste and danger, then to redesign the process to improve these areas. Techniques such as time studies, Pareto charts, and process flow mapping were used to analyze the existing process. A new process was designed, and recommendations were made for improvements in customer service and safety. A survey of customers at The Pad was used to test the recommendations. The survey results showed a large majority agreed that they would be more satisfied with each recommendation that was proposed. The new process was implemented and evaluated using a second set of time studies. The result was a reduction in total process time from 4.5 hours per route to 3.3 hours per route, a 27% improvement. This is equivalent to a cost savings of \$24 a route based on average wages for a route setter. Based on an estimated 240 routes set per year, this would save The Pad \$5760 a year.

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I. Introduction

This project will improve the route setting process at The Pad Climbing, an indoor rock climbing gym in San Luis Obispo. The report will describe the current process as well as a proposed new process design.

Formerly named SLO Op Climbing, the company tore down their old facility and opened a new facility called The Pad in December 2017. Unlike the old location, the new gym features top rope and lead climbing in addition to bouldering. Top rope and lead climbing involve the use of a rope and harness for safety while climbing at greater heights, whereas bouldering the climber is closer to the ground and relies on crash pads beneath them to protect their falls. The scope of this study is the route setting process for top rope climbing.

Indoor rock climbing gyms offer customers a variety of ever-changing routes that emulate features of rocks found in outdoor climbing. A route is a series of hand and foot holds designated by a particular color. The goal for a climber is to get to the top of the wall using only the colored holds designated for the route they are climbing. This is a challenge of fitness and problem solving. Regular climbers are always looking for new routes to “solve”, which is why a successful climbing gym must constantly keep new routes available. For this reason, the gym will hire route setters who take down old routes and create new ones to keep climbers interested.

Problem Statement

The process of setting new climbing routes is time-consuming and has long changeover times and safety concerns. This results in higher labor costs and lower available capacity, which leads to a loss of potential customers and decreased customer satisfaction.

The idea for this project originated from our personal observation. We noticed that the process of route setting at the gym was time-consuming and that the areas of the gym being set could not be used by customers during that time. This reduces the overall capacity of the gym. Additionally, we noticed that the employees use ladders on unstable crash pads while setting new climbing routes, which is dangerous. After our initial observation of this problem, we spoke with the head route-setter and he agreed that the process could use improvement.

The main objective is to reduce the lead time for route setting by 20% using process improvement techniques learned throughout our IME coursework. The current process takes approximately 4.5 hours per route, depending on the number of holds on the route. The goal is to decrease this lead time to less than 4 hours per route.

The solution approach starts with doing a Gemba walk of the process and conducting time studies of the current process. Next, we will use process mapping techniques to model the current process. This includes creating a process flow diagram and floor layout. Then, we will create a pareto chart using the data and identify the areas of the process with the most room for improvement. We will identify muda (waste) and the bottlenecks of the process and look to eliminate or reduce them. A survey will be conducted asking the members of the gym questions

such as how often they would like routes reset. This will give us an idea of how often routes will be reset in the new process. Then we will consult with the route setters and ask them which areas of the route setting process they feel could be improved or they would like improved. After obtaining all this data, we will begin designing a new route setting process, focusing improvements on the areas most in need. The deliverables for this project will be a current state process flow diagram, time study results, survey results, a list of recommendations, and an updated process flow diagram.

We will implement our recommended changes to test the effectiveness of our design. We will calculate the time savings, the wall capacity improvement, and the subsequent monetary benefits. Once we have a benchmark for the effectiveness of our design, we will report our findings to the Pad.

II. Background

Indoor rock climbing involves different routes designated with colored hand and foot holds. The Pad Climbing uses various types of holds that each require a different technique. The following image explains a few of the common types of climbing holds.



Figure 1: Types of Climbing Holds

Each climbing route is given a grade, or level of difficulty. The grade is posted at the start of each route. Climbing grades are standardized for both indoor and outdoor rock climbing. However, grading is somewhat subjective and is determined by the route setters. The figure below shows the grading scale for both bouldering and top rope. The grades get progressively harder down the chart. At The Pad, the setters try to make sure there are enough routes of each difficulty available to entertain climbers of all skill levels.

Bouldering	Top-Rope
V2-	5.10a
V2	5.10b
V2+	5.10b
V3-	5.10c
V3	5.10d
V3+	5.10d
V4-	5.11a
V4	5.11a
V4+	5.11b
V5-	5.11c
V5	5.11c
V5+	5.11d
V6-	5.12a
V6	5.12a
V6+	5.12b
V7-	5.12b
V7	5.12c
V7+	5.12d
V8-	5.12d
V8	5.13a

Table 1: Climbing Grades

Literature Review

For a rock climbing gym to be successful and to keep attracting new members, one of the most important things to do is keep the routes constantly changing and challenging [6]. This is a major reason for the importance of this project and the setting process in general. Additionally, indoor rock climbing in general has been proven to help people with depression and people with autism [7][8]. It also is excellent at helping youth transition to adulthood by teaching invaluable techniques such as respect, goal setting, teamwork, and trust [9]. Consequentially, the more capacity The Pad can make available, the more the company can help people in the community.

It was important for us to research and understand how to determine capacity of a climbing gym based on the amount of wall space available to customers. We learned that for roped climbing there can be two active participants for every seven-foot-wide section of wall [5]. One of these is the climber, who is attached to the rope with a harness and is climbing the route. The other is the belayer, who is attached to the other end of the rope with a belay device. At the gym’s peak capacity, there will be one or two passive participants for every active one [5]. This means that in total the gym capacity for roped climbing is four people for every seven-foot-wide section of wall. This is just referring to linear horizontal width of the wall, regardless of height and area. At

The Pad, there is 210 feet of horizontal width available for top rope climbing. Using the previous stated logic, this means they have capacity for 120 people for top rope climbing.

After researching various methods for improving route setting processes, several computer-aided programs were discovered that have helped route setters set more unique routes to their exact difficulty specifications. A virtual route simulator has been used to allow setters to create a route on the computer and simulate how a climber would respond to it [12]. This allows the setter to not only see if the route works, but also see the difficulty and potential improvements they could make. A variation generator called Strange Beta is another useful computer tool, which randomly generates routes to increase variability and originality [13]. It takes the human bias out of setting routes and allows for an objectively designed wall to be created. A third useful tool is a program that allows the setter to take pictures of existing walls and upload them onto a computer model, creating an exact computer replica of the wall [14]. This allows quicker modelling of routes and allows for redesign and improvements to be made.

We discovered key insights into how to optimally run a climbing gym from a climbing wall operations and maintenance manual by Eldorado Climbing Walls, a company that constructs customized climbing walls for gyms [21]. A gym with top ropes should replace each rope at least once a year, or more often if they become worn or damaged. At The Pad, to replace the top ropes, an employee climbs all the way to the top of the wall with the new rope and replaces it from there. This manual suggests a better method. In this method of replacing a top rope, you tape one end of the new rope to the end of the old rope. Then, when you pull the old rope off, it will drag the new rope into place [21]. It also described the customer satisfaction benefits that arise from small actions such as naming routes, providing a route setting board allowing members to place comments about routes, and to always grade a route higher rather than lower when uncertain [21]. This is because “stroking egos is better for business than people falling on a grade they normally climb” [21]. They also recommend that a climbing gym should never let a setter set alone in the gym, especially when the gym is closed or late at night [21]. If a setter was to become injured when alone in the gym, the injury could go unreported for a long time.

Many process improvement techniques were used in this study. A key part in process improvement is the identification and elimination of waste [3]. Waste is anything your customer would not be willing to pay for [3]. When analyzing a process, it is helpful to always refer back to the customer and how the work is adding value for them. The seven forms of waste are inventory, delay, motion, transportation, overproduction, over processing, and defects [3]. All of these wastes can be found in the setting process at The Pad. Time saving can be made by identifying specific elements of the process that fall under one of these categories and are unnecessary. When waste is reduced, costs decrease because the process is more efficient [15]. The goal of any process improvement effort is to reduce costs by a greater amount than the investment costs put into the process improvement effort [17].

A process improvement tool used in this report is a process flow chart. A process flow chart is a graphical representation of a sequence of activities used to produce an output [2]. It consists of various symbols such as a rectangle for an activity and an arrow for transportation. Process flow charts are helpful in understanding the current process [20]. In order to make improvements on a

process, it is necessary to determine what is happening in the existing process. A key data collection tool used to analyze the activities in a process is a direct time study. This involves documenting complete information about the operation and recording times for several repetitions of the job [4]. Additionally, to complete the analysis, DMAIC was used which stands for define, measure, analyze, improve, and control [10]. Another tool, a Pareto chart, is used to identify the areas of the process with the most room for improvement [19].

A major process improvement barrier that was discovered is the people aspect when consulting with employees on tasks [1]. One issue that can often arise is a lack of employee moral because they think that management does not consider the workers when setting goals [1]. People in general also tend to resist any sort of change. Therefore, as Industrial Engineers, we need to be aware of the effect that our actions have on the people involved in the processes we are working on. While working with The Pad Climbing, we will need to keep in mind the goals and feelings of the employees, including both the setters and management. Employees are more likely to care about process improvement if it is obvious to them that changes are needed [18]. Thus, we need to ensure the setters feel there is something that needs to be improved, otherwise they will not implement the improvements. Similarly, if we ask the setters to record what frustrates them about the setting process, it will be easier to identify ways to improve the process [11]. Another potential problem is employees having a lack of clear responsibility when it comes to making changes [1]. This means that if no one is given explicit responsibility to implement changes in their tasks, the changes will not occur. This can be remedied by having a department or person in charge of enforcing the changes. Workers are also more inclined to implement changes if there is a reward for them for doing so [16]. Giving a setter more incentive will help bring changes to fruition.

III. Design

Customer Constraints and Requirements

- Must accommodate every setter/employee
- Must be financially feasible to implement
- Allow for employee creativity

Approach

1. Research existing climbing gym setting techniques
2. Conduct time studies
3. Create process diagrams
4. Identify areas for improvement
5. Survey customers
6. Develop new process design
7. Implement and test new process with time studies
8. Estimate time and cost savings

Design

Our first step was to discover more about the setting process in place at The Pad. The head route setter verbally walked us through the process. Then, we observed the process on a day when two route setters were working on setting two new top rope routes. Figure 3 below depicts the entire process flow from start to finish.

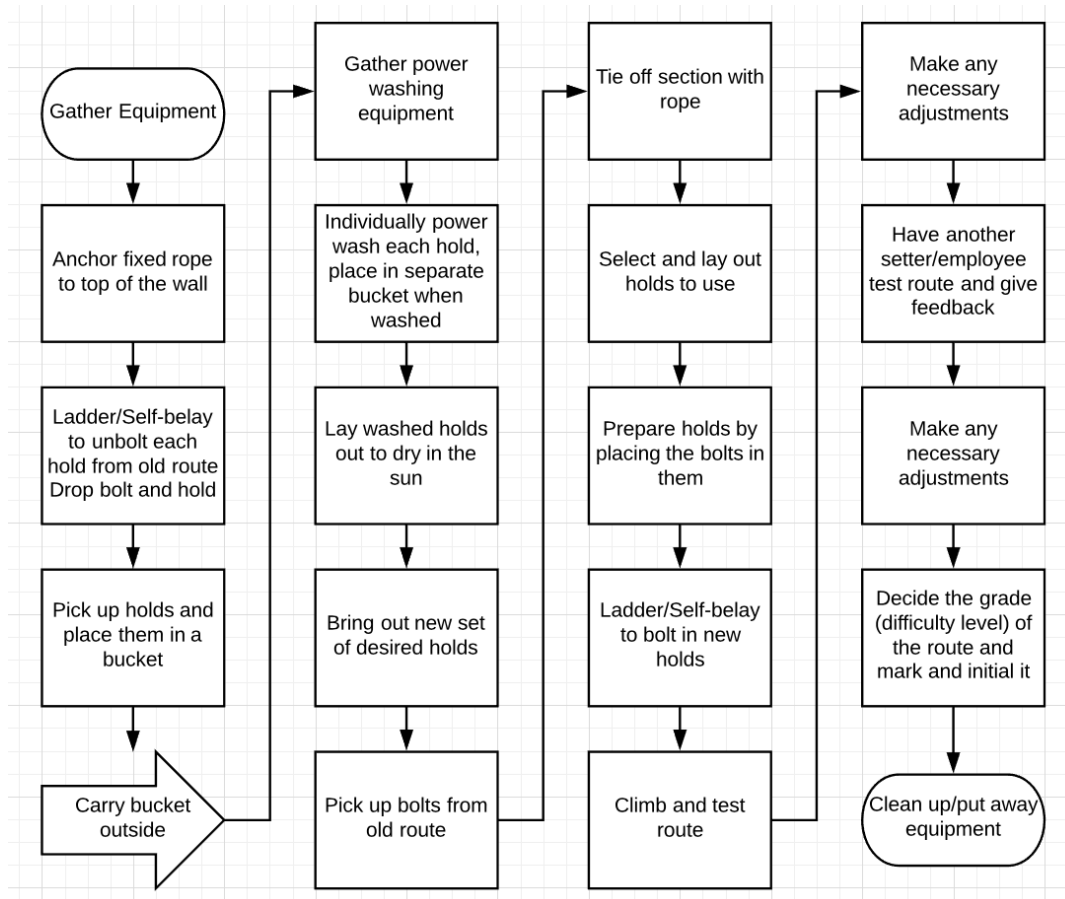


Figure 2: Current Process Flow Diagram

We took videos of the entire process as they were setting and were then able to break down the time taken for each step by using a combination of a stopwatch and the time stamps off of the videos. Figure 4 below shows the time taken for each of the process steps. Immediately, we observed that the most time-consuming step is actually bolting the new holds onto the wall.

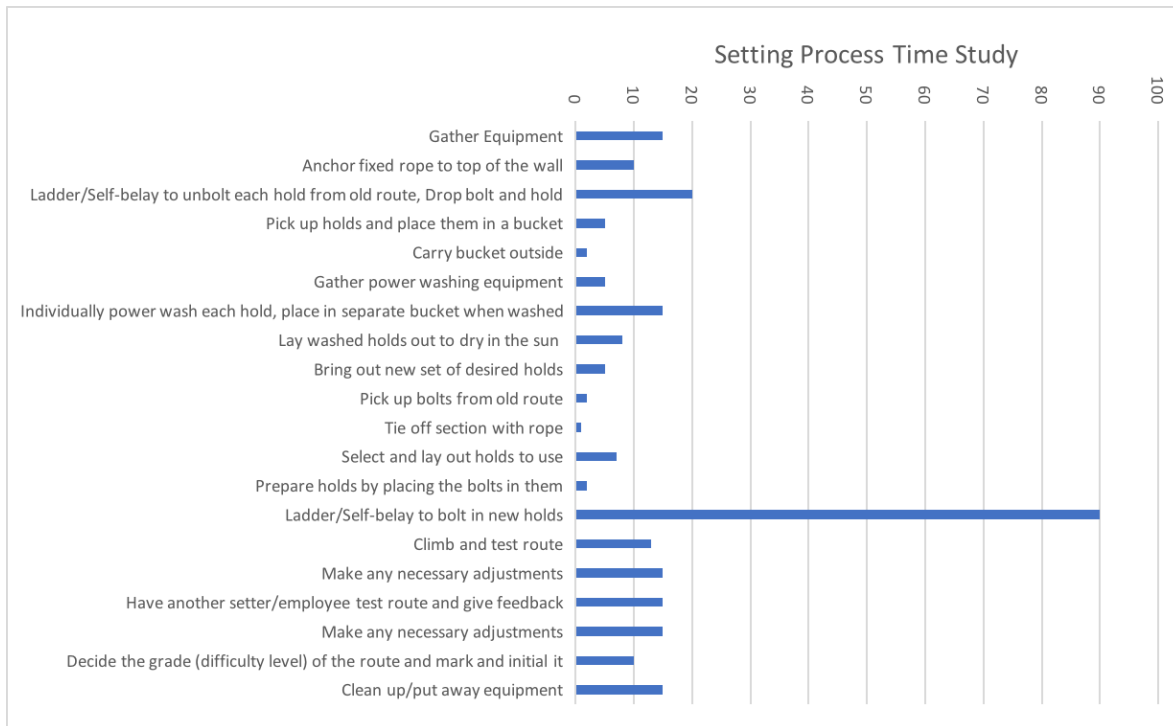


Figure 3: Current State Time Study Results

Recommendations

We came up with recommendations for improvements in efficiency, safety, and customer satisfaction. First are the improvements we recommended to improve the efficiency of the setting process. The first recommendation was to tie the top rope to a fixed object instead of using a separate rope. This eliminates the 10 minutes required to climb to the top of the wall to anchor another rope to the top of the wall. Securing one end of the existing top rope works the same way. Next was to use a bucket when taking down the old route rather than dropping the holds on the floor. This will reduce the risk of holds falling on people, decrease the probability of holds breaking or damaging the floor, and eliminate the time it takes for the setters to pick up the fallen holds and bolts. We also recommended investing in a second power washer. We estimate that this will cut the power washing time in half because the two setters will not have to take turns washing holds. A new power washer costs about \$200. We also recommended power washing the holds after they are completely done setting rather than right after they take down the old holds. This way, they can use that time to complete the new route before the gym is open for customers. Then they can power wash outside of the gym after the gym opens. Another improvement is to store the equipment behind the walls in the rope area rather than the storage closet on the other side of the gym. There is space available there and this will save time in setting up and putting away the equipment. We also found that the setters often will forget things like the drill or bolts and will have to go back down to get them. To prevent these errors, we recommended making a checklist of items needed for setting so they can double check that they have everything before they go up to set. After the route is set, we recommended adjusting the

route as they test it instead of testing the whole thing before adjusting the route. This will save time and reduce going up and down the wall multiple times.

Additionally, we made recommendations involving safety. These recommendations resulted from our research of general safety standards and the safety policies in place at other rock climbing gyms around the country. The first safety recommendation is to require setters to clip into the rope when on ladders at heights greater than 15 feet. This will reduce the risk of setters falling off the top of the ladder. The next recommendation is to not allow setters to set alone in the gym. This ensures a setter will have someone to help them if they injure themselves. Setters should use larger holds towards the bottom of routes because they are heavier and can cause more damage if they fall. It is better ergonomically, as well, as setters will not have to carry heavier loads up the walls. They should replace cracked or broken holds as soon as possible because they can injure climbers and setters. Lastly, they should not set when customers are present to avoid injuries to customers. Even though they rope off the area where they set, they are still close enough where customers can be injured from a falling object.

Our last recommendations are for improving customer satisfaction. These recommendations were also a result of our research of methods other gyms have implemented that have proven successful for customer satisfaction. We recommended having a route setting board to allow members to comment on routes and allow setters to comment back. This creates a fun atmosphere where setters can get feedback on the routes they are setting, and climbers can give feedback on the routes they are climbing. Next, is to have a consistent route setting schedule. This means scheduling in advance which areas of the wall will be reset and when. This will allow climbers to know in advance when new routes will be up, so they can plan accordingly. Additionally, when unsure of what grade a route is, go harder rather than easier. This reduces frustration from customers and builds confidence, as they are able to do seemingly “harder” routes than they think they can. Lastly, place names on routes in addition to just the grade. This creates a sense of fun and community and makes it easier to refer to the routes.

There were a couple other design alternatives that we came up with but decided not to test. One was to have two setters per route so they could work together and complete the route faster. We thought this would be problematic because the setters take ownership of their routes and like to have creative say over them. Setting with another person would violate that ownership. This would also require more employees setting, which would increase labor costs. Thus, it was not tested. Another idea we considered was to have setters plan routes ahead of time using software. We decided against this idea for our project because it would require expensive software and there would need to be a map of the entire gym's walls and features. Also, it would be difficult for the setters to visualize climbing moves because body position is not as intuitive on paper as it is in person. Most setters rely on testing moves in person to decide where to put holds.

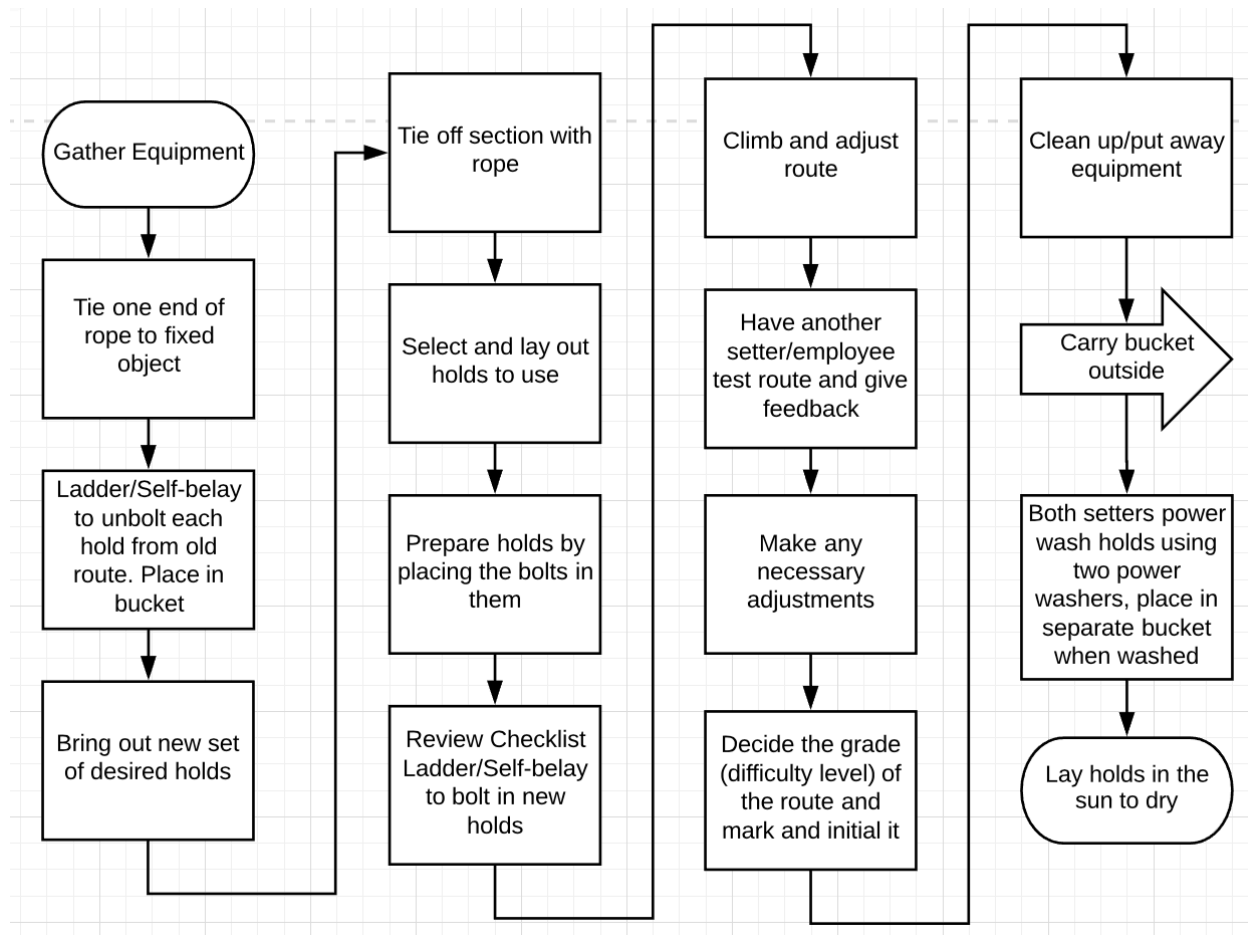


Figure 4: Improved Process Flow Diagram

IV. Methods

Improved Process Time Study

To test the improvements for efficiency, we redid time studies on the new process and analyzed the differences between the old and the improved processes. The following graph shows the new steps and their associated lead times.

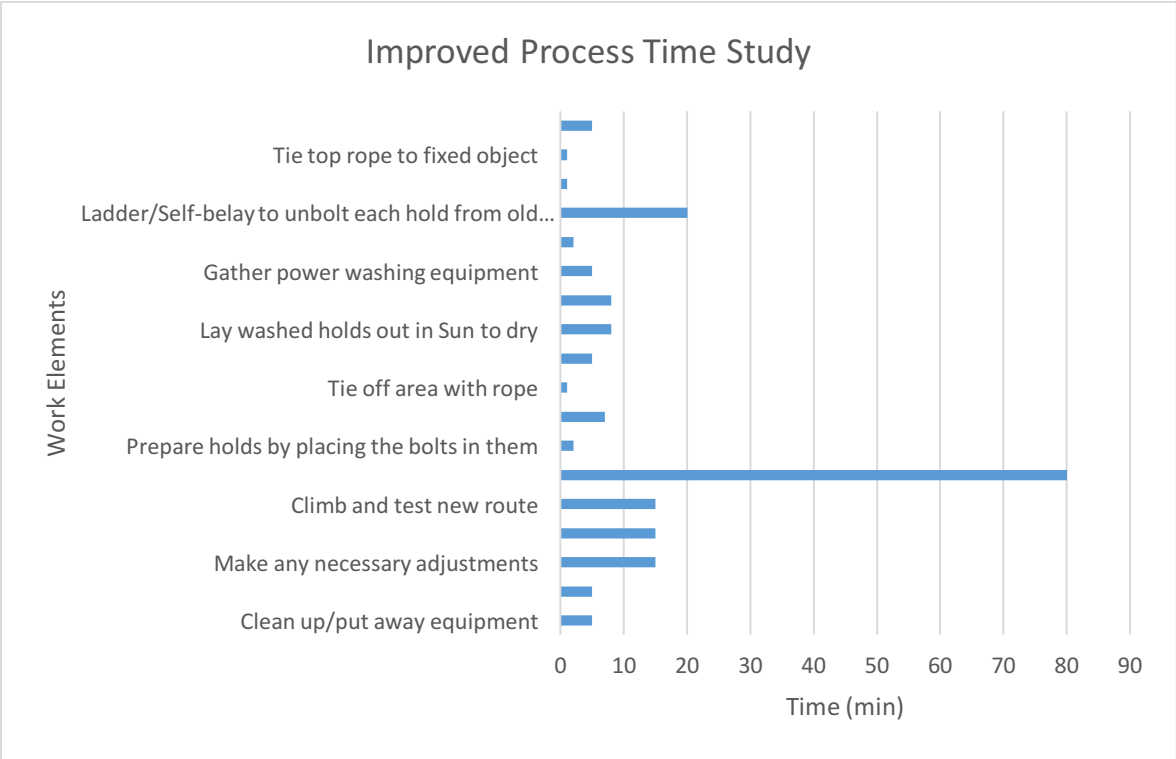


Figure 5: Improved State Time Study Results

Survey

To estimate the effect of our suggestions regarding customer service, we conducted a survey of 50 random climbers at The Pad. These customers were selected randomly in person during a busy time at The Pad. The results from the survey were as follows:

1. Would you like if routes had unique and creative names written on the start hold tags?

ANSWER CHOICES	RESPONSES
Yes	94.00% 47
No	2.00% 1
Don't Care	4.00% 2
TOTAL	50

Table 2: Survey Results Route Names

2. Would you use a route setting comment board where members could provide feedback on the routes and setting and receive responses from the setters?

ANSWER CHOICES	RESPONSES
Yes	84.00% 42
No	2.00% 1
Wouldn't use it, but think others might	14.00% 7
Not sure	0.00% 0
TOTAL	50

Table 3: Survey Results Comment Board

3. Would you like to be able to a predetermined route-setting schedule that shows dates and locations of the next reset?

ANSWER CHOICES	RESPONSES
Yes	100.00% 50
No	0.00% 0
Don't Care	0.00% 0
TOTAL	50

Table 4: Survey Results Route-Setting Schedule

4. Which bothers you more: when a route is harder than the listed grade or when a route is easier than the listed grade?

ANSWER CHOICES	RESPONSES
It bothers me more when a route is harder than the grade	96.00% 48
It bothers me more when a route is easier than the grade	4.00% 2
TOTAL	50

Table 5: Survey Results Route Grades

5. How satisfied are you with the frequency of setting at The Pad?

ANSWER CHOICES	RESPONSES
▼ It's just right	12.00% 6
▼ I wish they would set more often	88.00% 44
▼ They set too much and I am not done working on the routes before they are removed	0.00% 0
TOTAL	50

Table 6: Survey Results Setting Frequency

The results from the survey were entirely consistent with our recommendations. Customers seemed to support our ideas of adding names to the routes and putting up a route setting commend board. 100% of customers wanted to be able to see a predetermined route setting schedule. 96% of customers agreed that it is frustrating when a route is harder than the grade, which supports our idea that customers feel better when a route is too easy rather than too hard. 88% of customers wish that they would set more often and the remaining 12% said it is just right. With the increased efficiency from our new process design, they will have the resources available to increase the frequency of setting.

V. Results and Discussion

Time Savings

By storing holds, ladders, and other equipment behind the walls, the time to gather and put away equipment is reduced to 5 minutes. This saves 20 minutes for the entire process. Anchoring the existing rope rather than using a separate rope saves 10 minutes per route. Having a bucket up on the rope to collect old holds and bolts saves 4 minutes per route. Moving the power washing steps to the end of the process allows setters to do more of the process inside the gym before customers arrive. Power washing can be done outside during open hours. This saves 23 minutes from the process. Additionally, testing and adjusting the route as the setter goes saves 5 minutes from the process, as it eliminates climbing up and down the wall numerous times. Having a checklist of all the materials saves 10 minutes of going up and down the wall to retrieve materials, as well. Grading harder rather than easier as a rule of them saves about 5 minutes from deciding the grade.

	Original State	Improved State
Fixed Time	30 min	10 min
Variable Time	6.86 min/hold	5.43 min/hold
Average Time per Route	4.5 hours	3.3 hours

Table 7: Time Study Comparison

Assuming there are 35 holds per route on average, the improved fixed time is 10 mins, and the improved variable time is 5.43 mins/hold, or 190 mins/route. The improved total time for setting one route is 3.3 hours. This is 1.2 hours less than the original lead time of 4.5 hours and a 27% improvement.

Economic Analysis

The only monetary cost associated with our new design is the purchase of a new power washer. Based on our research, we estimate that a new power washer will cost around \$200. Assuming a setter makes approximately \$20 per hour and our new design reduces labor time by 1.2 hours, the associated cost savings is \$24 per route. Therefore, they would break even after setting 9 routes using the new design. Assuming they set approximately 240 routes per year (based on an average of 20 routes per month during the time we were studying the process), this would result in \$5760 saved per year. This also assumes that they set the same amount as they do currently, whereas they could instead reinvest this time and increase the frequency of setting to improve customer satisfaction.

Secondary Impacts

There are some secondary impacts that could result from our design. Fewer employees, or fewer hours from each employee, will be needed to set the same number of routes. If they don't increase the number of routes they set, this could result in a loss of jobs. There will also be an expectation to set routes within the 3 hours before the gym opens. Currently, the setters do not feel time pressured because there is an understanding that the process takes a long time and will continue even when customers are present. If the gym owners set the expectation that setting will not happen when customers are present, there will be a lot more pressure on the employees and will change the culture of the company. Another impact is if they increase how often they set new routes, this will mean more holds needing to be power washed. This will require more water and energy. Lastly, the effects of increased capacity and improved customer service will result in parking being even more limited. They are already beginning to have issues with parking availability, and customers have begun parking in neighboring business's parking lots resulting in many complaints from these businesses.

VI. Summary and Conclusions

The Pad Climbing was experiencing the effects of a time-consuming route setting process, from labor costs to decreased customer satisfaction. Our project aimed to improve upon this process using process improvement techniques to alter the process and come up with a new, more efficient process design. We also provided The Pad a series of recommendations for reducing safety risk for customers and employees and recommendations for additional ways to improve customer satisfaction. These recommendations resulted from our research and discussion with climbers and employees. A survey showed that these recommendations had an overwhelmingly positive response from the climbing community.

Our new process design resulted in an average time saving of 1.2 hours per route, a 27% decrease in total process time. This is equivalent to about \$24 saved in labor costs per route, or about \$5760 per year.

The results of this study should allow The Pad to save both money and time associated with setting new climbing routes. It will also allow them the ability to reallocate these resources to increase the frequency and number of routes set. We found from the survey that 88% of customers wish that they would set more often. The improved process should allow them to do this with the same amount of labor they were using before.

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