LOTO Management Structure: From Fermentation Strengthening and Stabilization to Maintenance Deployment

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Summary: This project is designed to improve the Logout/Tagout (LOTO) Management System for Bacardí's Fermentation, Distillery, and Maintenance Departments. Problems that currently exist are the continuous misplacement of devices, the LOTO box keys not being secured, and the documentation of LOTO activities being inconsistent. Analysis demonstrates that long travel distances and time are needed for large equipment lockouts (1,075.9 ft / 5.6 min for Quema 6, 1,508.4 ft / 7.8 min for Equipo C); smaller equipment lockouts are shorter. There is no ergonomic device placement inside LOTO rooms, no LOTO box key room with controlled storage, and no visual management when installing padlocks. These shortcomings make the company vulnerable to violations of OSHA and affect the efficiency of the LOTO operations.

D

Introduction

BACARDÍ is the world leader in rum production and sales. Cataño site, **responsible for 85% of Bacardí's global rum production**, produces 35K gallons of rum daily. The facility manufactures various rum products, including Bacardí Superior White, Bacardí Superior Gold, Bacardí 4 Years, Bacardí 8 Years, Bacardí 10 Years, and Bacardí Special Reserve.

Problem Statement

A disorganized Lockout/Tagout (LOTO) system within the Maintenance area causes regular device and key disappearances as well as padlock damage and delayed upkeep because employees cannot ascertain ownership in real time. Exposing to OSHA fines up to $161,323 per violation alongside additional expenses from padlocks and investigation processes thus requiring a Kaizen-based solution for Fermentation area prior to potential deployment in the Maintenance region for improved compliance and operational effectiveness.

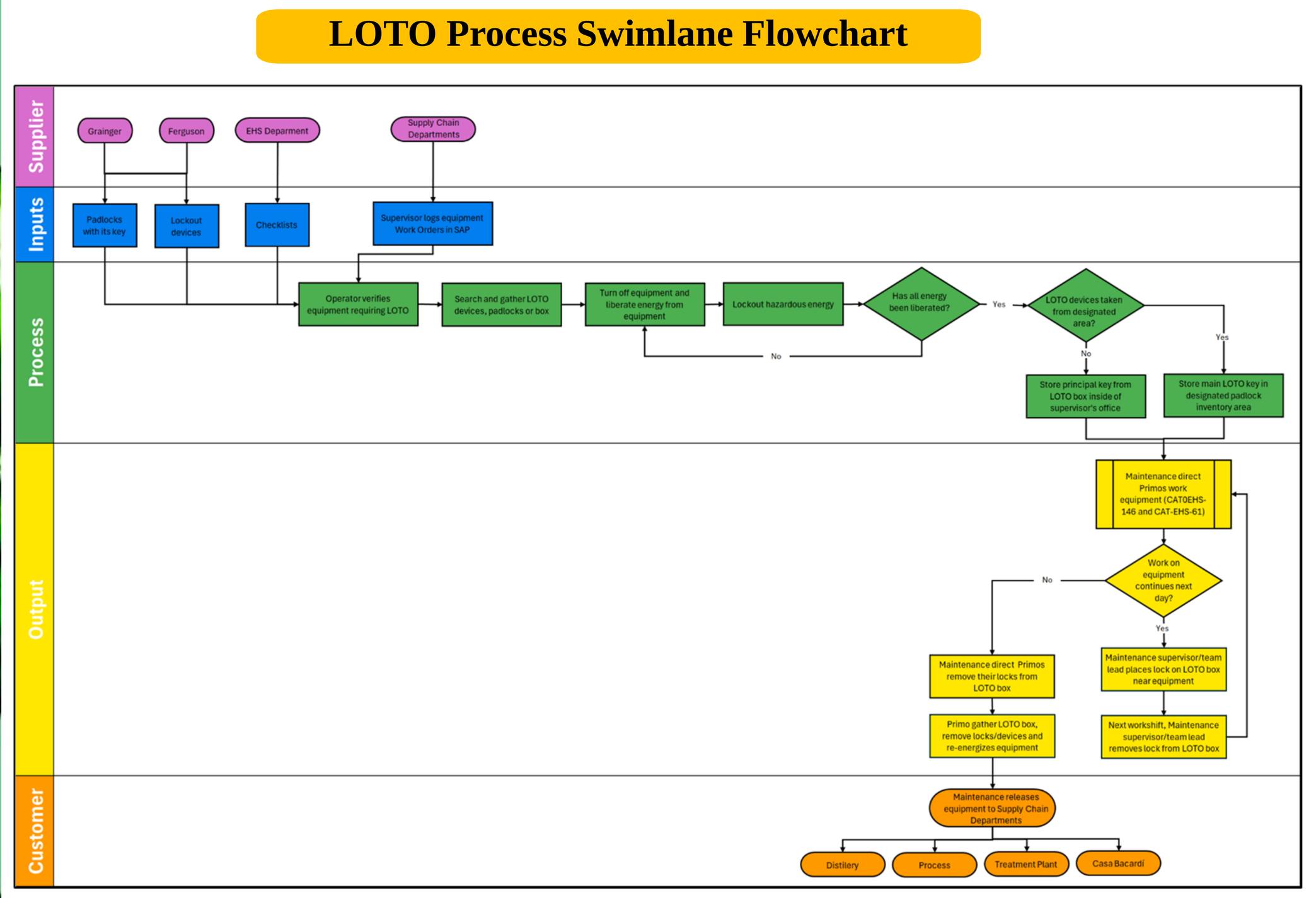
Voice of the Customer

For the Kaizen Event in the Fermentation LOTO Room, Primos (operators) were interviewed to identify LOTO concerns and ensure the system aligns with OSHA requirements.

Insights:

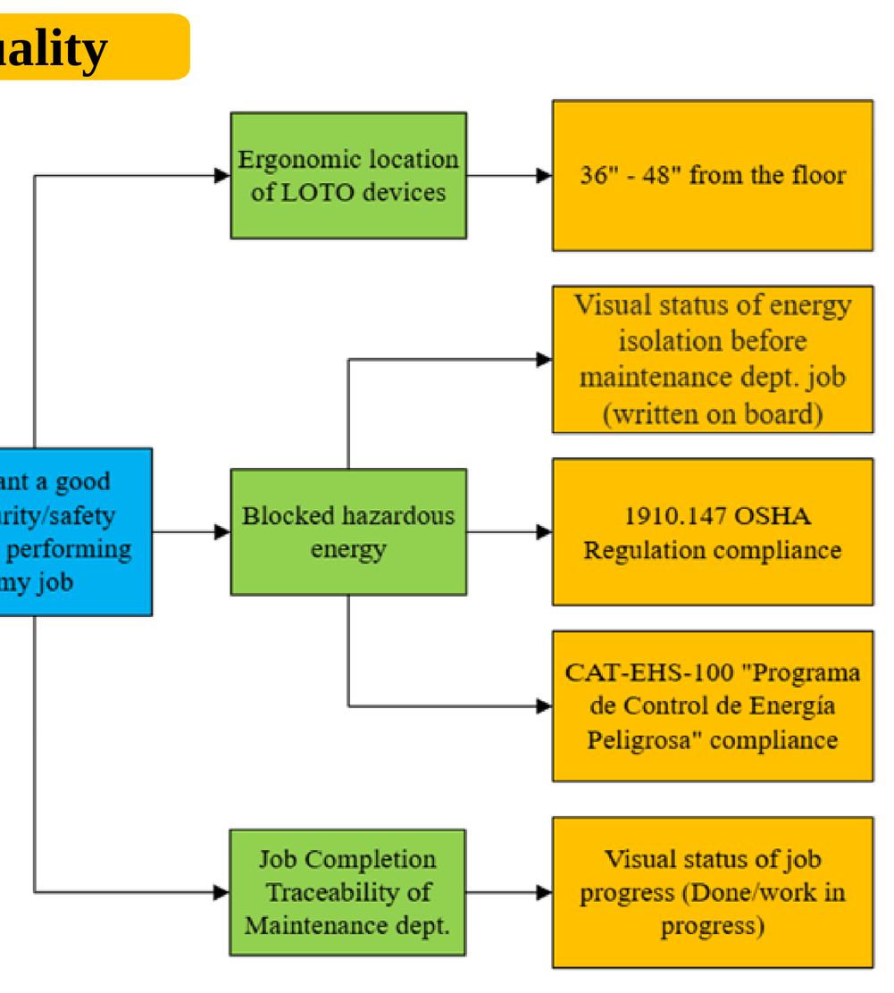
- Lack of a centralized LOTO station
- Misplacement and loss of keys are frequent
- LOTO documentation does not always match actual field practices
- Devices and locks are dispersed; not all personal padlocks are labeled with owner info
- Keys are stored without controlled access
- Absence of a real-time documentation system
- Some LOTO boxes are installed too low, making them ergonomically inadequate
- No table inside the room to support group LOTO boxes, making the process more cumbersome
- LOTO board lacks a clear visual indicator for job completion
- Lack of Visual Indicators for the Installation of Locks
- No standardized organization/inventory of padlocks
- External lockout devices required; recommend replacing valves with integrated LOTO provision
- LOTO boxes placed in inappropriate areas; recommend wall-mounting near fermentation tanks
- LOTO not performed in advance; recommend setup the day before scheduled maintenance.

LOTO Process Swimlane Flowchart



Critical To Quality

According to the VOC, Primos prioritized "good security/safety while performing my job." This led to three key categories: "Ergonomic location of LOTO devices" to prevent injuries from awkward movements, "blocked hazardous energy" to avoid equipment accidents, and traceability of job completions to prevent unintended equipment energization.



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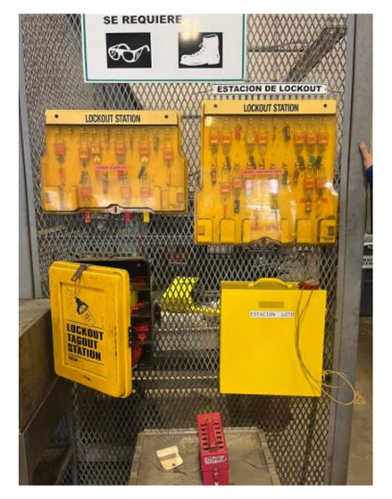
Current Distillery/Fermentation Logout/Tagout Room

Current Maintenance Logout/Tagout Station



Gap Analysis between Actual Situation, SOP, and OSHA Regulation

Compliance	Actual	SOP / "Programa de Control de Energía Peligrosa"	OSHA	Comments
	Mechanics are the only ones with blue locks.	"Mecánicos y operadores utilizarán candados azules" - 4.2.2.2	"Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tagout devices, print and format shall be standardized" - 1910.147(c)(5)(ii)(B)	
	Tagout is sometimes identified by the person who attached it and sometimes it is not. Cards have different formats. Not all the lockouts are identified by the employee.	"Tarjetas identificarán al empleado dueño de la tarjeta" - 4.2.4	"Lockout devices and tagout devices shall indicate the identity of the employee applying the device(s)" - 1910.147(c)(5)(ii)(D)	
	Tagout is sometimes installed on the loto box. Lockout and tagout are not installed together on the same location. Mechanics and electricians are not using tagouts.	"Hay equipos que no van a requerir la instalación de dispositivos, ya que proveen para poder instalar el candado y la tarjeta" - 6.3.3.6 "Se colocará candado y tarjeta al dispositivo indicando que se está trabajando con el equipo" - 6.3.4	"If an energy isolating device is not capable of being locked out, the employer's energy control program shall utilize a tagout system" - 1910.147(c)(2)(i) "If an energy isolating device is capable of being locked out, the employer's energy control program shall utilize lockout, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection as set forth in paragraph (c)(3) of this section" - 1910.147(c)(2)(ii)	"In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall use additional means like; the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization" - 1910.147(c)(3)(ii) "Tagout device attachment means shall be of a non-reusable type" - 1910.147(c)(5)(ii)(C)(2)
	Area lockouts/tagouts are removed by any of the group leaders or supervisors of the area.	"Los equipos de "lockout/tagout" serán removidos sólo y únicamente por la persona que los colocó" - 6.4.1	"Each lockout or tagout device shall be removed from each energy isolating device by the employee who applied the device" - 1910.147(e)(3)	
	Area employee responsible for the loto installs an area lock on the loto box (not a personal lock). From a pair of mechanics or electricians only 1 puts his personal lock on the loto box.	"Cada individuo envuelto colocará su candado en la caja del grupo de cierre ("group lockout box") asegurando las llaves" - 6.8.5.2	"Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work, and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained" - 1910.147(f)(3)(ii)(D)	
	LOTO process is developed, documented and utilized in Bacardí.	"Si no se consigue a la persona, no se puede identificar al dueño del candado o la persona no puede venir a removerlo, se requerirá la aprobación de personal de EHS para la remoción de este. Este evento se documentará como un "near miss" - 6.9.1 / 6.9.1.3	"Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section" - 1910.147(c)(4)(i)	"When the authorized employee who applied the lockout or tagout device is not available to remove it, that device may be removed under the direction of the employer, provided that specific procedures and training for such removal have been developed, documented and incorporated into the employer's energy control program" - 1910.147(e)(3)

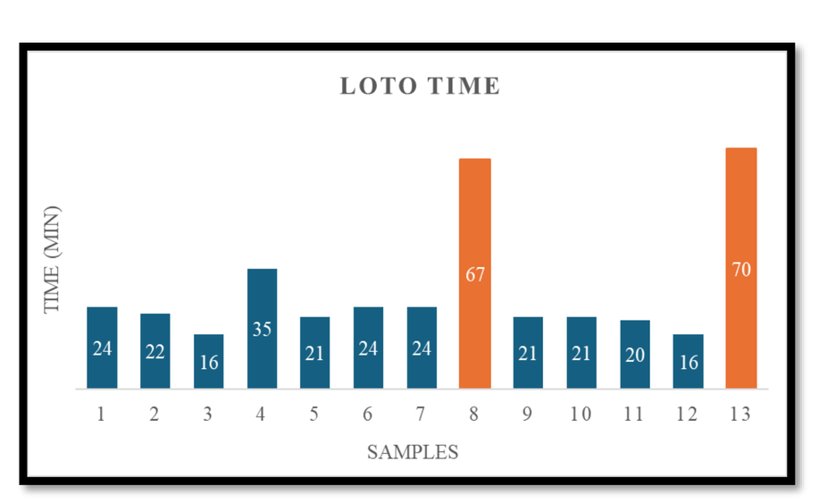
Major offenders

1. No control/storage method for LOTO keys
2. No recorded status of LOTO jobs and LOTO energy control (task progress status)
3. No recorded data on who installed the LOTO box padlock

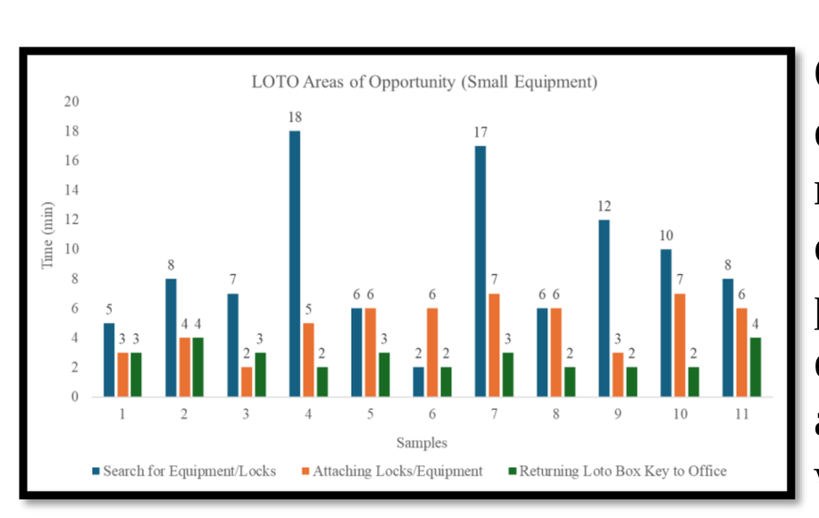
Leyend	
Color	Definition
(red)	No Compliance between three Categories
(yellow)	No Compliance between two Categories
(green)	Full Compliance

LOTO process tagouts are inconsistently applied, with some reused and lacking standardization, despite SOP requirements. Lockout devices follow a color standard (blue for operators and mechanics), but in practice, only mechanics use them, and tagout identification is inconsistent. Additionally, while individual lockouts must be removed by the same employee who applied them, group lockouts can be removed by any group leader, operator, or supervisor in the area, creating gaps in control.

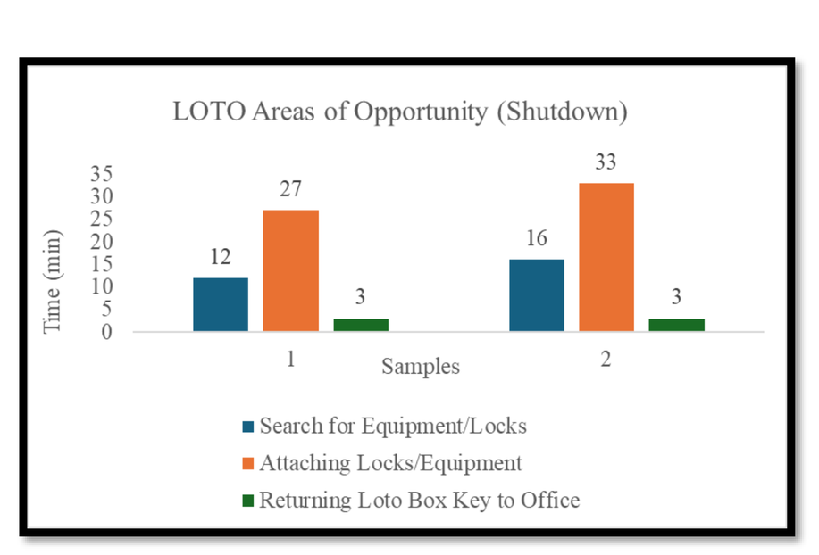
Analysis of Data Collected



13 samples were analyzed; samples 8 and 13 represent large equipment (plant shutdowns), while the rest are small equipment. Small equipment (blue bars) requires less time due to its size and simplicity, while large equipment (orange bars) takes longer due to complexity/size. The graph shows the total time it took to complete LOTO for each equipment type.



Of the 13 samples, 11 are inside the small equipment category. The LOTO times that are represented in this graph are what the group considers as the areas of opportunity for this project, since these are the steps (search for equipment/locks, attaching locks/equipment, and LOTO Box key return) where most of the waste/non-value-added activities are located

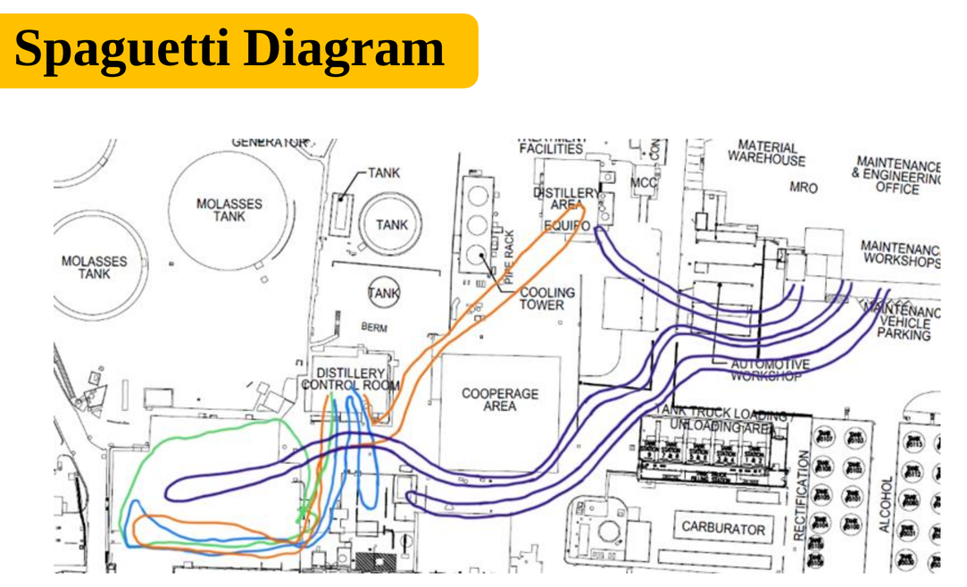


2 of the samples are inside the large equipment category, pieces of equipment that are locked out 3 times a year, during plant shutdowns. LOTO times in this graph are the same as the Small Equipment graph, but now concentrating on samples 8 and 13.

Spaguetti Diagram

Total Distance Covered / Walking Time in Shutdown Loto:

- 1075.9ft = 5.6 min
- 1508.4ft = 7.8 min



Total Distance Covered / Walking Time in Small Equipment Loto :

- 664.2ft = 3.8 min
- 1016.4ft = 5.3 min
- 230.1ft = 1.2 min
- 734.3ft = 3.8 min
- 618.8ft = 3.2 min
- 585.3ft = 3.3 min

Leyend

- Quema 6
- Equipo C
- Maintenance Facilitator (Quema 6, Equipo C, and Clarificación)
- Clarificación

The LOTO process spaghetti diagram was built to visualize each equipment's path and distance with travel time. This way, the group can appreciate the true scale of the transportation/motion time and some of the non-value-added activities inside the process.

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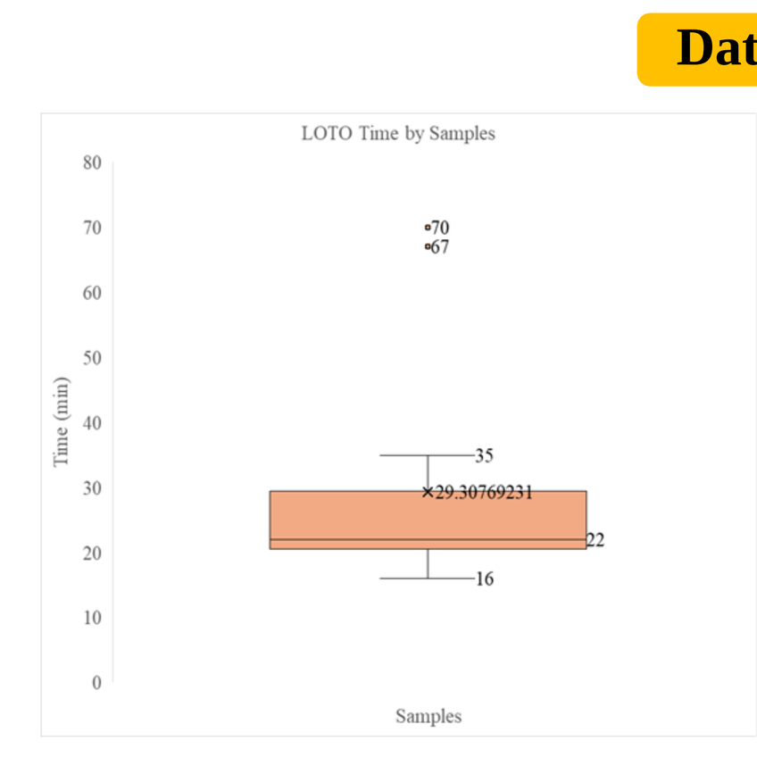
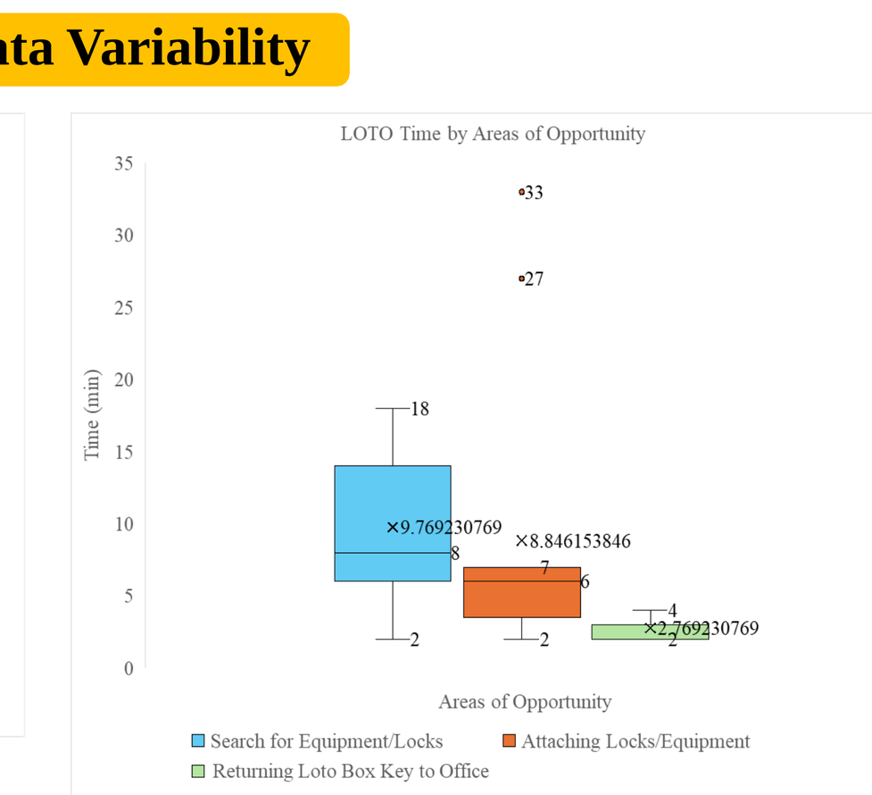
Data Variability





The size and complexity of the equipment determine the LOTO time duration. Less time is required for Lockout/Tagout on small equipment due to its simpler design and fewer isolation points, resulting in quicker execution. Large equipment, represented by the two outliers of 70 and 67 minutes, takes much longer due to the complexity and total number of energy points. The time wasted looking/gathering equipment and locks is the primary source of inconsistency.

Descriptive Statistics without Large Equipment

LOTO Time (min)	
Mean	22.18
Median	21.00
Mode	24.00
Standard Deviation	5.10
Range	19.00
Minimum	16.00
Maximum	35.00

Search Locks (min)	
Mean	9.77
Median	8.00
Mode	8.00
Standard Deviation	4.95
Range	16.00
Minimum	2.00
Maximum	18.00

Deviation is due to long travel distances/wait times caused by unnecessary back-and-forth motion looking/gathering LOTO devices/tools. Most of the data is concentrated around points 8-16 (minutes), reaffirming the large variability that exists within the data.

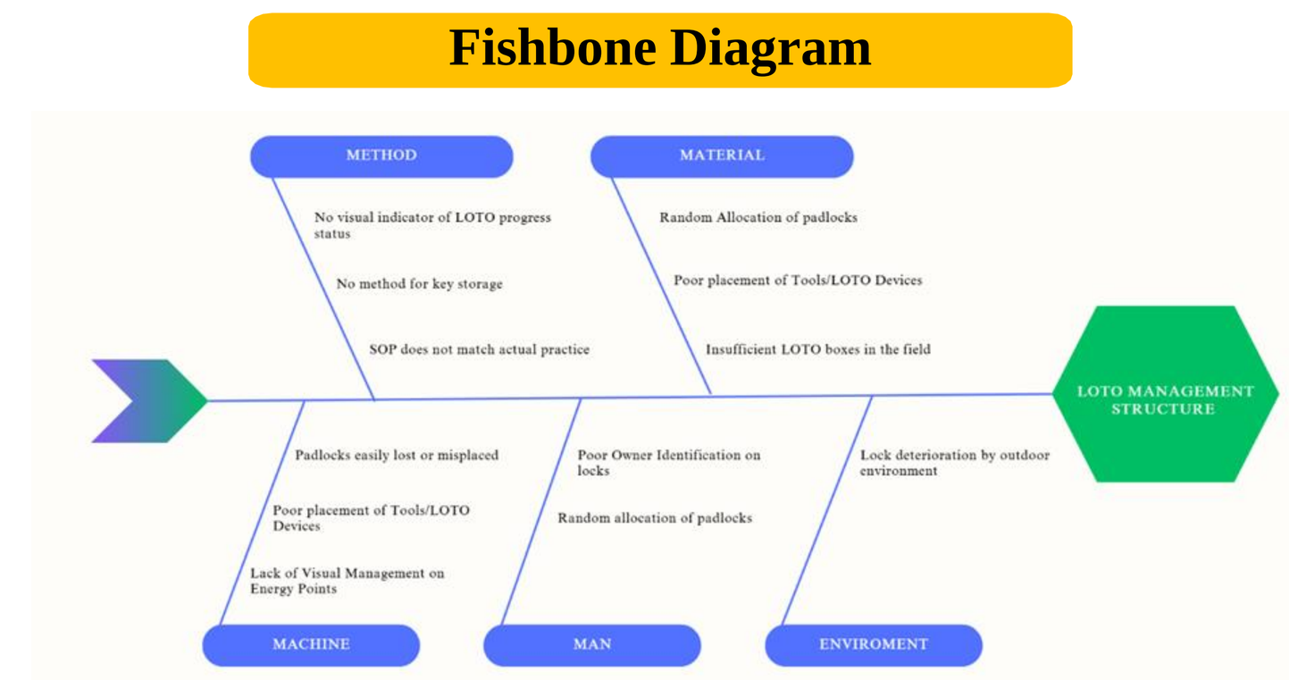
Install Locks (min)	
Mean	5.00
Median	6.00
Mode	6.00
Standard Deviation	1.73
Range	5.00
Minimum	2.00
Maximum	7.00

Deviation is due to Primos being undecided on lock installation locations, travel distance from the last location on the "search locks" stage to the equipment, and from lockout point to lockout point. Most of the data is concentrated around points 4-7 (minutes), showing a large variability, but in this case is largely affected by the location of the equipment.

Return LOTO Key (min)	
Mean	2.77
Median	3.00
Mode	3.00
Standard Deviation	0.73
Range	2.00
Minimum	2.00
Maximum	4.00

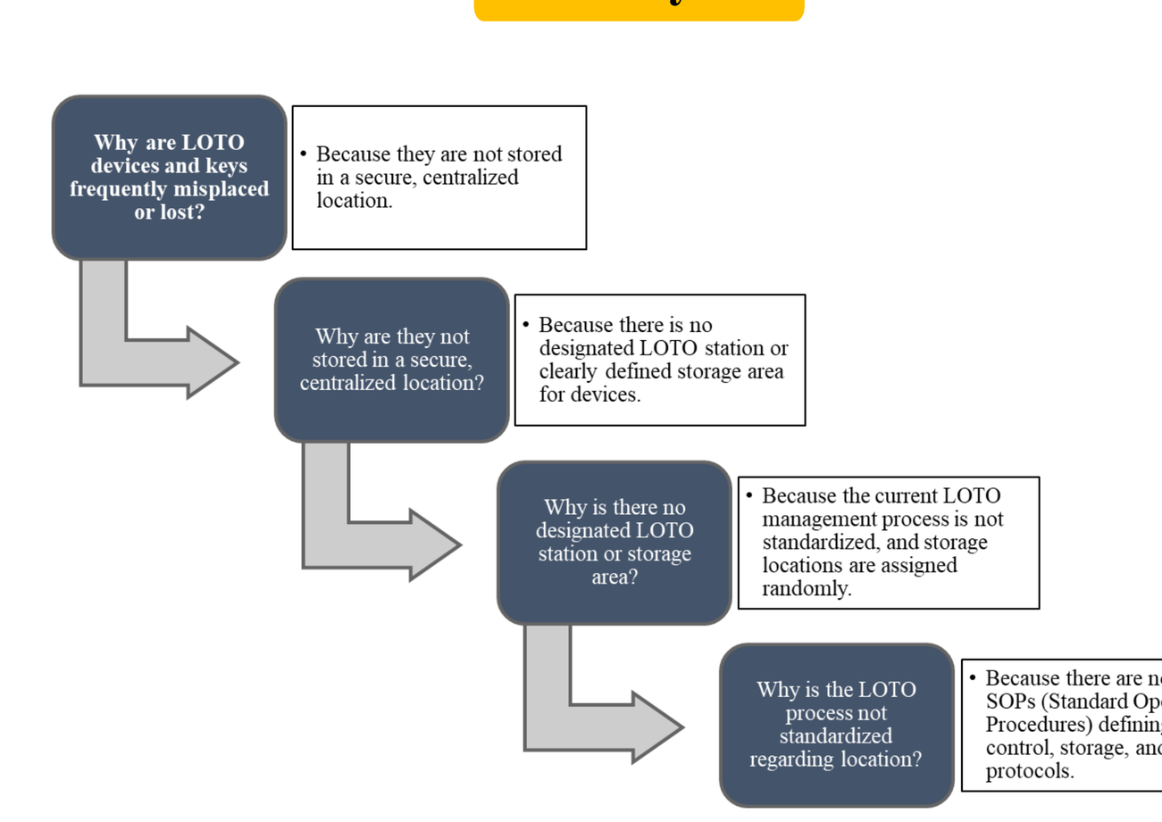
Deviation is due to the travel distance from the equipment to the office or LOTO room. Most of the data is concentrated around 2-3 (minutes), showing a low variability. In this case, the deviation is affected by the location of the equipment in relation to the office/LOTO.

Fishbone Diagram



1. No method to store LOTO keys, padlocks/devices, and LOTO boxes (random storage areas).
2. Poor identification of who did the LOTO and who installed the Maintenance Department's padlock on continuous jobs.
3. Locks that are stored outside are being damaged by the environment, preventing their opening/closing.
4. Lack of visual indicators on equipment, indicating where the locks/devices should go
5. SOP does not match actual field practice.

5 Why's



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Solution Selection Matrix

Root Cause	Potential Solutions	LOTO Time Reduction	Cost of Implementation	Impact on Safety	Time to Deploy	Overall	Take Action
Everyone has access to LOTO box keys without any method for control	Install key lock boxes that only the facilitators can open/close	2	10	10	10	2000	Yes
LOTO devices/tools scattered around different parts of the distillery/fermentation department	Separate distillery/fermentation departments LOTO rooms by implementing a new room inside the distillery department	10	10	4	7	2800	Yes
Lack of visual aid when installing padlocks on equipment	Attach a visual indicator on energy points to facilitate identification when performing a lockout	8	10	8	4	2560	Yes
Lack of control in padlock dispatch machine/counter in the maintenance department	Reduce total number of personnel with access to lock dispatch (facilitators, team owners, PO, and EHS team owner/SQS coordinator)	1	10	7	10	700	Yes
Lack of control in padlock dispatch machine/counter in the maintenance department	Design a form that personnel can write their names, quantity, and why it is being requested (purpose)	1	10	6	10	600	Yes

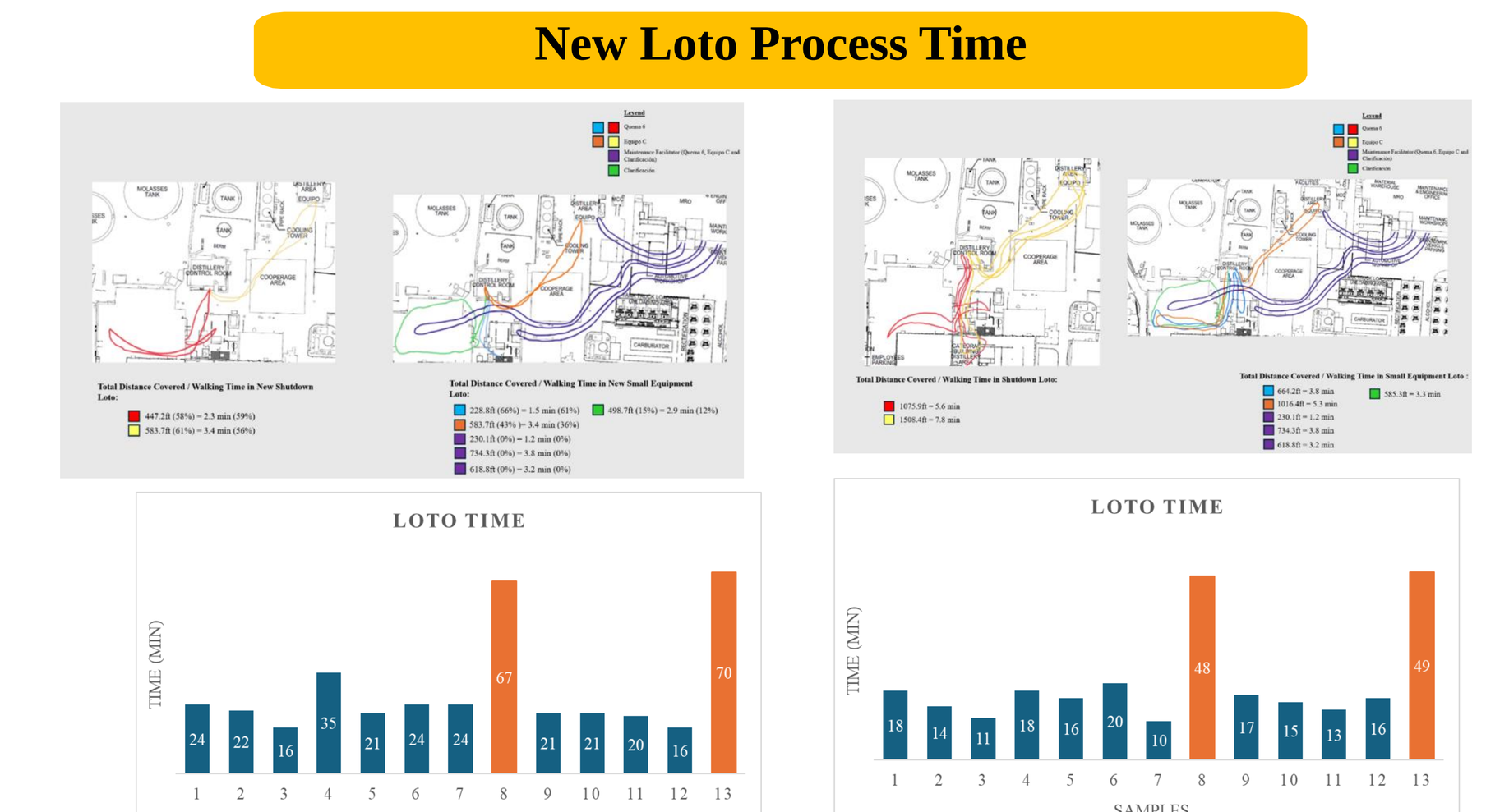
- LOTO time reduction = How much cycle time (minutes) can the solution reduce
- Cost of Implementation = Cost of the solution's implementation
- Impact on Safety = Positive impact the solution has on Primos' safety inside the workplace
- Time to Deploy = Time it will take to implement the solution

Cost of Implementation

Solution	Benefit	Cost per unit	Total Cost
Key lock box 50 key spaces	Prevents unauthorized key access and ensures OSHA compliance for LOTO box handling.	$49.99 + handling cost	$73.62
Key lock box 75 key spaces		$59.99 + handling cost	$85.53
New LOTO room in Distillery Lockers	Establish a new LOTO room in the Distillery to centralize tools and eliminate unnecessary back-and-forth during the lockout process.	Already have the materials in inventory for the LOTO Room.	N/A
Visual Management on Energy Points	Install visual indicators on energy points to guide padlock placement and reduce cycle time.	$19.99 Pack of 25 Labels + handling cost (x5)	111.39$
Padlock Vending Machine and Counter Control Form	Limit padlock dispatch with a tracking form to control usage, enhance safety, and reduce material waste.	Created using Forms	N/A
5S in Fermentation, Distillery, and Maintenance Departments	A 5S will be implemented in Fermentation, Distillery, and Maintenance to relocate LOTO materials to strategic areas, reducing process time, motion waste, and item loss.	Rearrange of the display	N/A
		TOTAL	$270.54

Cost analysis of implementation is conducted to evaluate relationships between the proposed LOTO management structure improvements and the operation, as well as the compliance benefits it yields. Implementation costs and available budget allocations determine the economic feasibility of the solutions for reducing cycle time, avoiding OSHA non-compliance penalties, and increasing operational efficiency.

New Loto Process Time



The implementation of the recommendations to Bacardí's Lockout/Tagout (LOTO) process, shortened walking distances, and process travel time by over 50%. Shutdown LOTO routes were shortened by over 50%, and all small equipment LOTO routes were under 4 minutes. These are the results of focused interventions like the creation of a new LOTO room, visual energy point signs, and a 5S-based organization. Also, processing data shows a dramatic reduction in mean and variability, with outliers decreasing from highs of 67 and 70 minutes to 48 and 49 minutes. This trend shows better standardization, elimination of motion waste, and greater safety and effectiveness throughout the LOTO process.

Solutions

LOTO Inventory for Process	LOTO Room	Distillery Lockers	Maintenance dept.
Padlocks with Keys	70	88	36
LOTO Boxes	12	6	0
Cable Locks	3	10	0
Gate Valve Lockouts	4	0	0
Ball Valve Lockouts	14	0	0

Key lock boxes were implemented in the Fermentation, Maintenance, and Distillery departments for controlled access to LOTO Box keys and adhering to OSHA requirements. A new LOTO room was established in the Distillery for keeping tools in one place and minimizing unnecessary movement. A 5S system was rolled out department-wide to sort and transport LOTO materials strategically and reduce motion waste and tool loss. A padlock tracking system was implemented with a standard request form and a Power BI dashboard to monitor usage trends and prevent material waste. Furthermore, a visual job progress indicator was integrated into the LOTO Room board to help communicate maintenance status and reduce the risk of accidental re-energization of equipment. These solutions introduce safety, efficiency, and standardization throughout Bacardí's LOTO procedures.

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Actions

I. Key Lock Box Access Control
Only authorized personnel (facilitators, process owners, team owners, and team leaders) may access key lock boxes located in Fermentation, Maintenance, and Distillery.

II. Visual Indicators on Energy Points
Regularly inspect and replace visual indicators at energy isolation points if missing or damaged. Clear labeling supports quick identification, reduces indecision, and ensures cycle time consistency.

III. Padlock Dispatch Tracking
Maintain strict padlock dispatch control through a standardized request form and QR code. All data should be logged into an Excel file connected to a Power BI dashboard. Monthly reviews are recommended by the MRO leader.

IV. 5S System Maintenance
Conduct quarterly 5S audits in all LOTO stations (Fermentation, Distillery, Maintenance) to ensure items are in place, accessible, and labeled. Any deviation should trigger corrective actions.

V. LOTO Job Progress Visibility
Use visual job boards to communicate the progress of maintenance tasks. Supervisors should update the board during their shifts and verify logs against formal documentation.

VI. Training and SOP Updates
Provide annual refresher training and revise the LOTO SOP (CAT-EHS-100) to reflect current practices and user feedback. Encourage team members to report deviations and suggest improvements.

Tool	Purpose
Power BI Dashboard	Track padlock dispatch trends, frequency of use, and control violations.
5S Inspection	Ensure LOTO stations remain clean, organized, and compliant with standards.
Visual Job Status Board	Visually confirm completion of maintenance tasks in the LOTO Room.
Supervisor Walkthroughs	Perform random inspections to ensure compliance and reinforce accountability.
SOP Review	Validate alignment of the procedure with real-world practices.
Feedback Mechanism	Use the Voice of the Customer to collect suggestions and concerns from Primos.

Financial Analysis

Labor Cost Reduction					
LOTO/Year	Minutes Reduction/Year	Hours Reduction/Year	Hourly Pay	Primo/Task	Savings/Year
178.00	1324.00	22.06	$23.00	1	$507.38
Cost Avoidance					
	Bought Quantity	Price/Unit	Total Price	% Reduction	Reduction Total
2024 Padlocks	168.00	$7.53	$1,265.04	70.00%	$888.54
2026 Padlocks	50.00	$7.53	$376.50		
Cost Avoidance					
Category	**Description**				**Amount**
Pump	Replacement				$20,000.00/day
Quema 6 / Equipo C	Replacement				$60,000.00/day
Compressor	Replacement				$200,000.00/day
Breaker	Replacement				$15,000.00/day
Injuries	**Description**				
Burn	Average compensation and treatment cost per burn related injury.				$99,000/injury
Fracture	Average cost including medical expenses and compensation per burn related injury.				$115,000/injury
Electric Shock	Injury involving electrical current exposure.				$332,000/injury
Laceration	Average cost per cut/laceration injury including treatment and compensation.				$46,000/injury
Fines	**Description**				
Serious	A hazard exists that could result in death or serious physical harm, and the employer knew or should have known of the danger.				$ 16,550.00
Other-than-serious	Related to safety or health but not likely to cause death or serious harm.				$ 16,550.00
Posting requirements	Failure to display OSHA-required notices in the workplace.				$ 16,550.00
Failure to abate	Not correcting a previously cited violation within the time allowed.				$16,550/day
Willful	Deliberate disregard or indifference to legal requirements.				$ 165,514.00
Repeat	Recurrence of a similar violation within a five-year period.				$ 165,514.00

Thanks to the implementations, Bacardí will be able to save **$507.38** per year in labor pay (from $1,608.08 to $1,106.54 = 31% reduction) and reduce padlock buying quantity per year (from $1,265.04 = 168 padlocks to $376.50 = 50 padlocks) by approximately 70%, resulting in approximate savings of **$890** a year. In total, Bacardí will be saving $1,395.92 per year. In addition to the savings, Bacardí will reduce the probability of an accidental injury/machine replacement and increase OSHA regulations compliance, resulting in the cost avoidance of fines and extra costs.

Conclusion

The Control stage ensures the consistency of the improvements in Bacardí's Lockout/Tagout (LOTO) process with the implementation of standardized procedures and monitoring mechanisms into ordinary operations. Main enhancements, installing secured key lock boxes, the creation of a dedicated LOTO room, and the utilization of visual energy point markers, will reduce inefficiencies like redundant walking time, misplaced tools, and safety risks introduced by ambiguity or forgetfulness. LOTO keys and QR code padlock request forms are accessed by authorized personnel only, allowing real-time usage tracking through a Power BI dashboard. This adds security and accountability.

For long-term performance, the team included quarterly 5S audits to continue maintaining organized workspaces, as well as visual job status boards to track in-progress maintenance shifts. Reviews are led by supervisors to ensure compliance with the updated SOP (CAT-EHS-100), reviewed once each year, and supplemented with routine training. Feedback is also collected from front-line workers through a Voice of the Customer process to identify areas for improvement. Combined, these control systems foster a culture of ownership and ongoing improvement throughout Bacardí's operations.