OPERATIONAL ASSESSMENT: WEIGH YOUR PALLET WRAPPING OPTIONS USING AN ENGINEERED APPROACH

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The binding or wrapping of outbound palletized product is a necessary function of all manual selection operations in distribution services. A common question we are asked by many operations is: "Who should be wrapping our pallets, and how should we wrap them?" The answer is likely to change based on your operational characteristics. In this paper, we will explore three common pallet wrapping techniques found in distribution centers and provide a justification for the best option based on the overall operational impact on a targeted warehouse.

The target warehouse for this study was a foodservice distribution operation that averages over 3,800 pallets per week in output using manual selection on triple pallet jacks and manual dock loading. Included in the study will be the operational impact of seven operational variations for pallet wrapping based on the three common techniques:

- Manual wrapping
- Robo wrapping
- Tunnel wrapping

All elemental activities and time values are based on actual observations conducted by the workforce optimization team at West Monroe Partners over the last several years. The study does not include the initial capital investment for automated pallet wrapping equipment because of the large range of cost and supplier options. Also excluded is the cost and delay associated with mechanical breakdowns of the automated processes.

PALLET WRAPPING OPTIONS

The three pallet wrapping techniques in this study will be referred to as manual wrapping, robo wrapping and tunnel wrapping.

Manual wrapping is the application of stretch wrap to the outbound pallet by an associate using a dispenser.

Image 1.0

In this process, the roll of wrap is hand-held by the associate as he/she walks around the circumference of the pallet until the pallet is sufficiently secured. To complete the activity, the associate holds and stretches the roll until the stretch wrap breaks.

In robo wrapping, a self-propelled robotic wrapper is positioned by an associate and the machine applies the stretch wrap.

Image 2.0

There are several providers of such machines, but each has the same general operation methods. The operator walks the machine from pallet to pallet, secures the end of the stretch wrap to the pallet and starts the machine from a control panel. The stretch wrap is typically cut by the machine at the end of the process.

The use of multiple stationary rotary towers spaced such that multiple pallets can be wrapped simultaneously will be referred to as tunnel wrapping.

Image 2.1

As the name suggests, the "tunnel wrapper" is an area with two or more rotary towers enclosed with guards and a perimeter guard which creates a tunnel effect. In this process, the selector will pull into the tunnel and disengage each pallet at the designated position. Once positioned, the operator will then start the machine from a control panel outside the active wrapping area. Once the process is complete, the selector will engage the pallets and proceed to the loading dock.

OPERATIONAL VARIATIONS

The following sections will detail the resulting time incurred by each job function and the net result on the operation as a result of each option. The results are based on a sample of over 4,300 job assignments accounting for nearly 12,000 pallets. In order to level the analysis across operational variations, the following considerations were made:

- Zero mechanical fault on wrap machines
- Selection batches were dropped at a single door

- All wrapping revolution frequencies are constant (c = pallet cube):
  - 54 < c <99 = 11 revolutions
  - 35 < c < 55 = 8 revolutions
  - 15 < c < 36 = 6 revolutions
- "Tunnel Wrapper" will always run for maximum cubed pallet of the order
- 1 second per pallet was added for extra distance traveled during disengage / engage maneuvers for the tunnel wrapper
- Proper loading dock set up allows for all robo wrap time to be internal to other Loader activities

Using the three defined wrapping options, there are seven operational variations we will explore:

	SELECTOR					LOADER			
	DISENGAGE	HAND WRAP	TUNNEL WRAP	ENGAGE	DROP PALETS	MOVE	HANDWRAP	RORBO WRAP	LOAD
V1	X	X		X	X				X
V2	X	X							X
V3	X		X	X	X				X
V4					X	X	X		X
V5					X	X		X	X
V6	X						X		X
V7	X							X	X

VARIATION ONE (V1)

In the first variation, the selector hand wraps the pallet before dropping the pallet(s) at the designated door. The methods include:

- Disengaging and engaging the pallets before and after wrapping
- Positioning the pallet(s) on the dock
- Dropping the pallet(s) on the dock with no separation

It was determined that the use of V1 for our test operation would result in an additional 3.5 minutes per selection assignment (approximately 1.32 minutes per pallet). The operation using 30 selectors who

average just over six batches per night would incur over 11.02 hours of additional time in the selection function. Loaders, completely absent of all wrapping activities, would have a capacity of 48.0 pallets per hour, excluding trailer set-up and closing. The overall (selection and loading) operational impact per pallet processed is 2.57 minutes. This process is more typical of smaller operations (less than 15k pieces per night) with limited dock space and loader staffing.

VARIATION TWO (V2)

In a process similar to V1, the second variation also requires the selector to disengage and wrap the outbound pallets. The key difference is that both disengage and wrapping activities are performed on the loading dock.

Our test environment would experience no change in loader capabilities – it would maintain the 48 pallets per hour from V1. The selection function in V2 would experience a 6.6% reduction in wrap time when compared to V1. The same 30 selector operation would experience a total of 10.27 hours of wrap time. The resulting per pallet impact on the overall operation is 2.48 minutes.

VARIATION THREE (V3)

V3 is the last option that requires selectors to commit time to wrap the outbound pallets, and the first to employ the use of mechanized wrap machines. V3 requires the selectors to stage the pallets to be wrapped by a series of rotary wrappers known as a tunnel wrapper. The selectors pull into the designated wrapping area and disengage the pallets onto specific positions within the tunnel. Once the selector's pallet jack has been pulled clear of the area, the selector walks to a control panel and starts the wrap machine.

For our test environment, we planned for the purchase of two tunnel wrap machines for each department, for a total of six machines. Because the machines are static, and the selectors must pass through before proceeding to the loading dock, a delay analysis was also performed. Again, the load function will experience no change in processing capabilities, maintaining 48 pallets per hour, excluding trailer set-up and close. A total of 4.66 hours of wrap-related time will be absorbed by the selection function; a reduction of nearly 60% when compared to V1, and easily the least burdensome of the three options considered thus far. The overall per pallet impact for the operation was 1.78 minutes.

Unlike the previous variations, there are two conditions with V3 that must be considered. The first is that the machines are stationary and as a result all selectors must pass through them before proceeding to the dock. In the event of a mechanical delay or failure, a contingency plan must be available to ensure continuous workflow. The second point is that the set up creates a single point of system delay. An analysis of our test operation indicated that selectors in the three department system would experience delays on 23.6% of the

batches entering a two-tunnel system at the end of each department. Delays ranged from 0.17 minutes up to 3 minutes. Because these delays are highly variable and may differ by site, set-up or manufacturer, they were NOT used as part of the calculation in this study. In the case of our target operation, this is an indication that the current operating conditions must be monitored and/or changed if this option proves the most desirable.

VARIATION FOUR (V4)

V4 is the first option that accounts for the loader performing the pallet wrapping. In this set-up, the selector simply positions and drops the pallets on the loading dock. From there, the loader will move the pallets and hand wrap each one before loading them into the trailer.

The result is an impact on the overall Selection function of only 15 total minutes (0.25 hours) over the entire shift. This is a reduction of 97.8% from V1 and is tied with V5 overall as the least impactful option for selectors. The loading capabilities fall from 48 pallets per hour to 24.4 due to re-allocated wrap time. The total amount of time incurred by the test operation was 2.48 minutes per pallet.

VARIATION FIVE (V5)

The use of robo wrappers will be considered for the first time in V5. In V5, the selectors will position and drop the pallets on the loading dock. The loader will then separate the pallets and position the robo wrapper to wrap each pallet. The use of the robo wrappers allows for the pallets to be wrapped while the loader is performing other tasks, such as loading a previously wrapped pallet.

V5 has the same impact on the selection function as V4, totaling 15 minutes (0.25 hours) of time associated with pallet wrap activities. Because the loaders can now perform other tasks while the machine is wrapping pallets, the capability of the load function now increases to 41 pallets per hour, excluding trailer set-up and close. A total of 1.49 minutes per pallet is incurred by the total operation, the best of all options explored to this point.

VARIATION SIX (V6)

V6 requires the selectors to position on the dock and disengage the outbound pallets; the loader will then hand wrap each pallet. This operational set-up is most like V2, only the task of hand wrapping the pallets has been moved from the selector to the loader.

The total impact on the Selection function will be 39.7 minutes (0.66 hours) for the duration of the shift. The load function will have an overall capability of 25.0 pallets per hour and the overall operation will incur a total of 2.48 minutes per pallet.

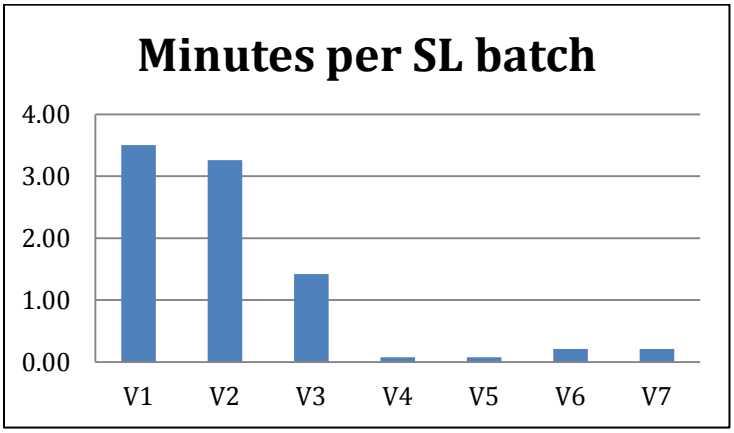
VARIATION SEVEN (V7)

The seventh and final variation for wrapping outbound pallets requires the selector to disengage the outbound pallets on the dock. The loader will then position the robo wrapper to wrap each pallet. Like V5, this option allows the loader to perform other loading tasks while the pallets are being wrapped.

V7 results in total of 39.7 minutes (0.66 hours) for the selection operation. The load function capabilities measure at 42.6 pallets per hour, the best level of all the Loader-wrapped options. The overall operational impact of 1.49 minutes per pallet is tied with V5 for the best of the seven variations.

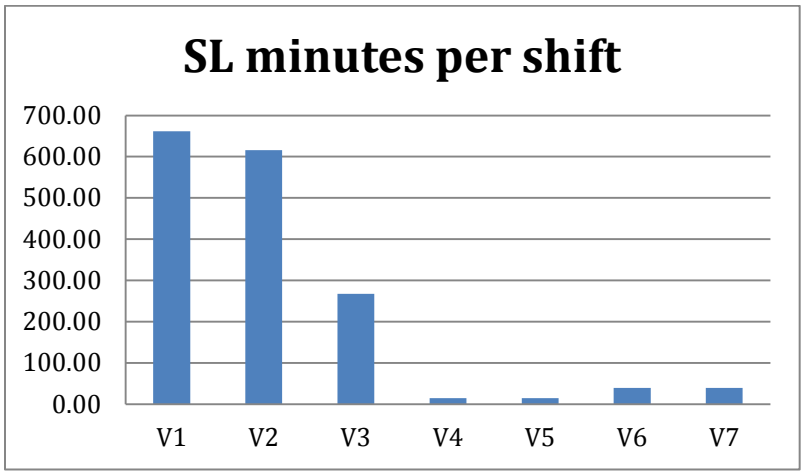
DIRECT COMPARISONS

Graphic 1 illustrates the additional minutes per selection batch that will be experienced given the operational variation that is selected.



Graphic 1

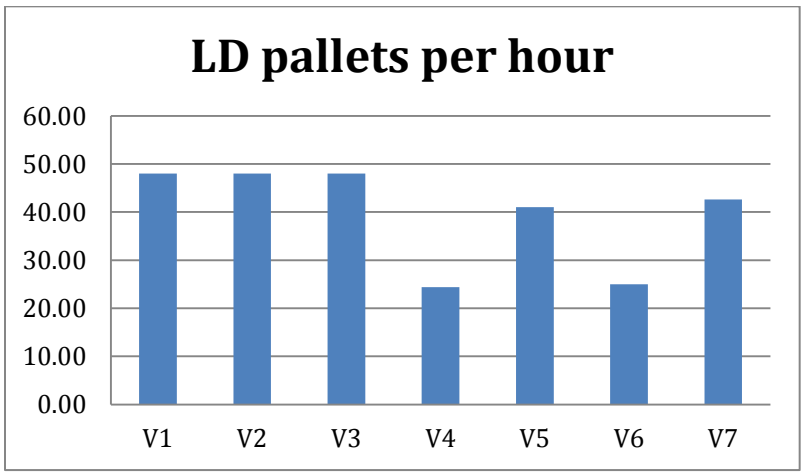
Graphic 2 expands the minutes per batch to indicate the impact on the total shift of 30 selectors over 189 batches.



Graphic 2

As expected, Graphics 1 and 2 clearly indicate that the best way to minimize the impact on the selection function in the operation is with Variations 4 – 7: moving the work within the load function. Moving the pallet wrapping to the load function has an impact of varying degrees, depending on the method of wrapping.

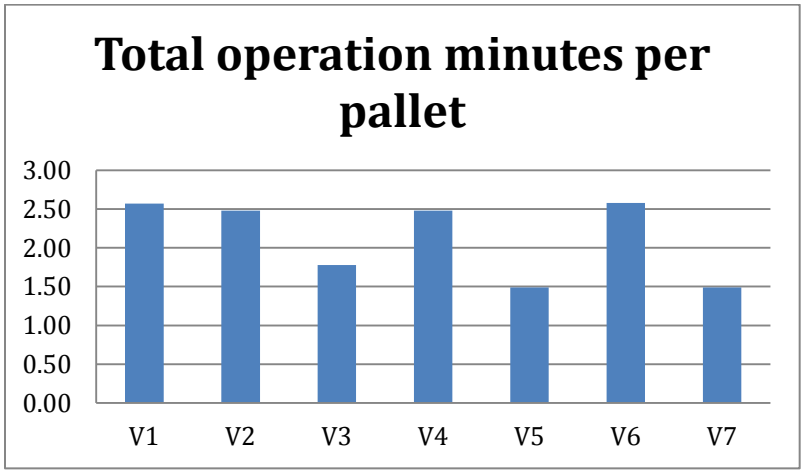
Graphic 3 details the impact of each variation on the loader pallets per hour.



Graphic 3

Pallets per hour capabilities are greatest when the selectors are wrapping pallets by any means and are the lowest when the Loaders are wrapping. The introduction of the robo wrappers in V5 and V7 allows for higher capabilities because the loaders can do other work while the machine is wrapping.

The final graphic presented, Graphic 4, illustrates the total amount of minutes per pallet that the operation will incur across the seven operational variations.



Graphic 4

In Graphic 4, it is apparent that the least amount of operational impact is experienced in Variations 5 and 7, the robo wrappers. These are followed closely by Variation 3, the use of the tunnel wrappers.

FINAL DECISION

Using a decision matrix and ranking each measured category is helpful in the final decisions for this process.

	MINUTES PER SELECTION BATCH	SL MINUTES PER SHIFT	LD PALLETS PER HOUR	TOTAL OPERATION MINUTES PER PALLET	AVERAGE SCORE
V1	7	7	1	7	5.5
V2	6	6	1	4	4.3
V3	5	5	1	3	3.5
V4	1	1	7	4	3.3
V5	**1**	**1**	**5**	**1**	**2.0**
V6	3	3	6	4	4.0
V7	3	3	4	1	2.8

CONCLUSION

This analysis was focused solely on the operational impact of each variation. Before making any changes to your operations, it is important to consider all aspects of your operation, including the capital investment, as it compares to the data provided here. While V5 may not be right for your operations, it illustrates a framework for evaluating your operations so that you can make the right changes to improve productivity and efficiency.

When considering capital investment for facility modifications or automation, remember to factor in all aspects of your operation. All investments and automations may sound good on paper but industrial engineers trained in operational optimization and cost analysis can help model the impact specific to your day-to-day operations.

Photo Credits

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