A System Study on the Outbound Operations of a Philippine FMCG Company's Distribution Center

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Abstract: The FMCG company in this study produces and markets products which include some of the country's well-known brands. The study focuses on the dwell time problem of outbound operations of the said company's largest distribution center. Dwell time refers to the total time an outbound truck stays inside the premises of the distribution center from gate in, loading and gate out. In 2014 to 2015, the distribution center has not been meeting their target dwell times. Seven contributory causes which involved prolonged and delayed start of certain warehouse processes were identified and validated by analyzing the dispatch plan of the distribution center. In order to address the prolonged truck dwell time, solutions involving changes in process sequence, introduction of a new machine, improvement of warehouse documents, and an introduction of new warehouse personnel functions were recommended. These were validated by incorporating the new process times and sequences to the warehouse operations, to determine if a certain solution led to an improvement to the cause it aims to address. Overall, the solutions allowed the outbound processes to be performed within the target standard outbound dwell time, and led to a 44 % improvement in the outbound warehouse capacity.

Keywords: Warehouse, Logistics, Distribution Center, Dwell Time, Outbound Operations

1. BACKGROUND OF THE STUDY

A Multinational FMCG company in the Philippines carries the country's leading brands in the food and beverage industry. Out of all the categories under the FMCG goods, the food and beverage items make up the largest bulk in the FMCG industry (Reckitt Benckiser Group, 2015), which the company in the study produces. With four production centers and five distribution centers, the company is able to serve both local and international clients in the South East

Asian region. According to Business World's Top 1000 Corporations in the Philippines (Almonte, 2012), this FMCG company was ranked within the top 20 corporations in the country.

This study encompasses the outbound warehouse operations of the company's and the country's biggest distribution center. The distribution center has an H Type layout and is partitioned into 3 warehouses based on stock type. Warehouses 1 and 3 stores only palletized stocks, while Warehouse 2 stores both palletized and case picked stocks. The distribution center's operations are run by a third party logistics service provider.

1.1. Objectives of the Study

The general objective of the distribution center is to deliver the stocks to its key accounts at the right time, in the right quantity, and in the right condition. Specifically, the following are the distribution center's objectives in terms of its key performance indicators:

Served – Unserved Stocks

The completeness, correctness, and quality of the stocks that were delivered to the customers. Measured by taking the ratio between the stocks that were accepted and the total stocks ordered.

Truck Utilization

The rate in which a truck's carrying capacity is utilized. Measured by getting the ratio of the number of stocks loaded and the truck capacity.

Outbound Dwell Time

The total time that the truck spends inside the distribution center premises.For the year 2014, the distribution center aims to achieve the following targets:

Table 1: KPI target values

KPI	Target Value
Served – Unserved Stocks	89 %
Truck Utilization	90 %
Outbound Dwell Time	5 hours 82.5 %

1.2. Present System

The outbound operations of the distribution center are partitioned into four stages, namely the Order Generation, Internal Stock Movement, Truck Loading, and Document Releasing.

1.2.1. Order Generation

The order generation stage is carried out by the DC outbound office personnel. Orders are received from retailers, distributors, or from the company's other distribution centers for re - supplying. Once the ordered stocks have been confirmed, an outbound delivery is reflected in the system. Afterwards, load planning is done in order to assign a truck that would deliver the stocks to the customer. The distribution center only assigns deliveries to canter trucks, wing vans, L300s, and container vans. Once a truck has been assigned, the tracking documents for the outbound delivery will be produced, and a "transfer order" for the stocks would be generated so that these could already be replenished, retrieved, or picked in the warehouse. These transfer orders are then sent and reflected in the warehouse personnel's barcode scanners.

1.2.2. Internal Stock Movement

The internal stock movement involves the stock replenishment for the storage bins with stocks that are already below its replenishment point. Stocks are retrieved from a storage bin either manually per case (picking) or through a reach truck (retrieval) for palletized orders. After these orders were picked or retrieved, these are staged until the truck that would deliver those stocks arrives in the DC premises. On the day of delivery, prior to truck arrival, the stocks are transferred or swept from the staging area to the loading bay and then checked based on a sweep list with quantities (or sweep – checking).

1.2.3. Truck Loading

The loading stage starts upon the arrival of the truck in the distribution center. Once the truck has already positioned in the loading bay, the trucker proceeds to the outbound office to obtain the tracking documents and a checklist of the stocks, per SKU and quantity, that are to be loaded into the truck. The trucker reconciles the stocks allocated into the truck against the checklist that was obtained earlier. Once the physical stocks match the SKUs and its quantities on the list, the trucker goes back to the outbound office to submit the checklist and returns to the loading bay to facilitate the truck loading. The distribution center utilizes 3 loading type, namely the manual loading, push – pull loading, and the pallet - pull loading.

Table 2: Loading types

Loading Type	Description
Manual	Requires the trucker to carry the cases into the truck
Push – pull	For palletized stocks with only slip sheets beneath a pallet load
Pallet – pull	Similar to push – pull but includes the pallet when loaded into the truck.

1.2.4 Document Releasing

After loading, truckers are required to submit the tracking documents back to the office for gate pass claiming and document releasing. Using the information from the delivery tracking documents, the outbound office personnel will change the stock status in the system from "picked" to "issued to the customer." Afterwards, the documents are forwarded to the billing personnel so that an invoice would be generated and printed. The documents and the invoice are brought to the trucking company's representative in the outbound office for documentation. Afterwards, the trucker goes back to the releasing personnel to claim the gate pass and the truck seal. Once the seal has been attached to the truck, the truck proceeds to the gate for a final inspection before exiting the distribution center premises.

2. PROBLEM DEFINITION

The distribution center's KPI hit rates for the year 2014 were considered and assessed in order to define the problem of the study.

2.1. Served – Unserved Stocks

For the year 2014, a total of 4,607,035 out of 22,008,450 ordered cases were not served to the customers. The ratio of served cases between the total number of cases ordered for year 2014 was at 80.37%, with 90 % as the target. The unserved cases resulted to money tied up amounting to Php 2,773,339.43.

2.2. Truck Utilization

The ratio of served cases between the total number of cases ordered for year 2014 was at 80.37%, deviating from the target by 8.29%. More specifically, of the 636 cases that a truck should at least carry, only 503 cases are loaded. Because of this, the distribution center has incurred a total of Php 17,991,000 worth of penalties that paid to the truckers due to underutilization.

2.3. Outbound Dwell Time

The average outbound dwell time deviated from the target by 0.46 hours which happens 7.41 % of the time. Due to its contribution to the timeliness of deliveries, the distribution center has incurred a penalty cost of Php 49,958,650.53. The penalty was paid to its customers whenever there is a late delivery is equal to 3 % of the invoiced amount of the stocks that the late truck is carrying.

2.4. Problem Statement

Upon assessment of the three KPI deviations' graveness, urgency, aggravation, resources, and significance on monetary penalty, the following problem was defined as:

The average outbound dwell time from January to December 2014 deviated from the target by 0.46 hours which happens 7.41 % of the time, thus resulting to a penalty of Php 49,958,650.53.

3. Problem Analysis

Since changes in some of the processes in the outbound operations were implemented by June 2015, a dispatch plan from September 2015 was used to determine and validate the causes of the problem. The warehouse dispatch plan used for validation included 978 outbound deliveries from September 6 to 12, 2015. At that time, 598 out of 978 outbound trucks did not meet the outbound dwell time target and were considered in the validation process. Samples from a Time and Motion Study conducted on the same month were also used for the cause validation. The time samples per process were compared with their respective standard time to determine whether the processes were prolonged or not.

During the cause validation, a process is considered to have a *delayed start* if its preceding process exceeded its standard time, thus, the process cannot start immediately. A *prolonged* process happens when its actual duration exceeded its standard time.

The final Why-Why diagram in Figure 1 shows the instances of the causes and their time contributions leading to a dwell time deviation. There are four main branches contributing to the late departure of trucks from the warehouse which results to exceeding the target dwell time.

3.1 External Factors

Instances of delayed departure of delivery trucks from the warehouse due to external or uncontrollable factors include trucker's personal breaks, inclement weather conditions, and the truck ban. External factors from the dispatch plan contributed 0.0870 hours to the total dwell time deviation of 1.93 hours for Sept. 6-12, 2015. The distribution center has no control over these factors.

3.2 Delayed Start in Truck Loading

Delayed start of truck loading, which contributed 0.9717 hours to the dwell time deviation is caused by either a prolonged or a delayed start in the process time of the preceding activities such as transport checking and sweep checking.

3.2.1 Prolonged Transport Checking
Miscounted stocks by checkers

Prolonged transport checking happens because the truckers miscount the quantities of the stocks listed in the checklist. As a result, transport checking is performed until the trucker's count finally matches the quantity in the checklist. Miscounting happens since some stocks of the same SKU are not stacked together on the same pallet by the pickers during the picking stage prior to sweeping the stocks to the loading bays. Prolonged transport checking contributed 0.2023 hours to the total delay time in the start of truck loading.

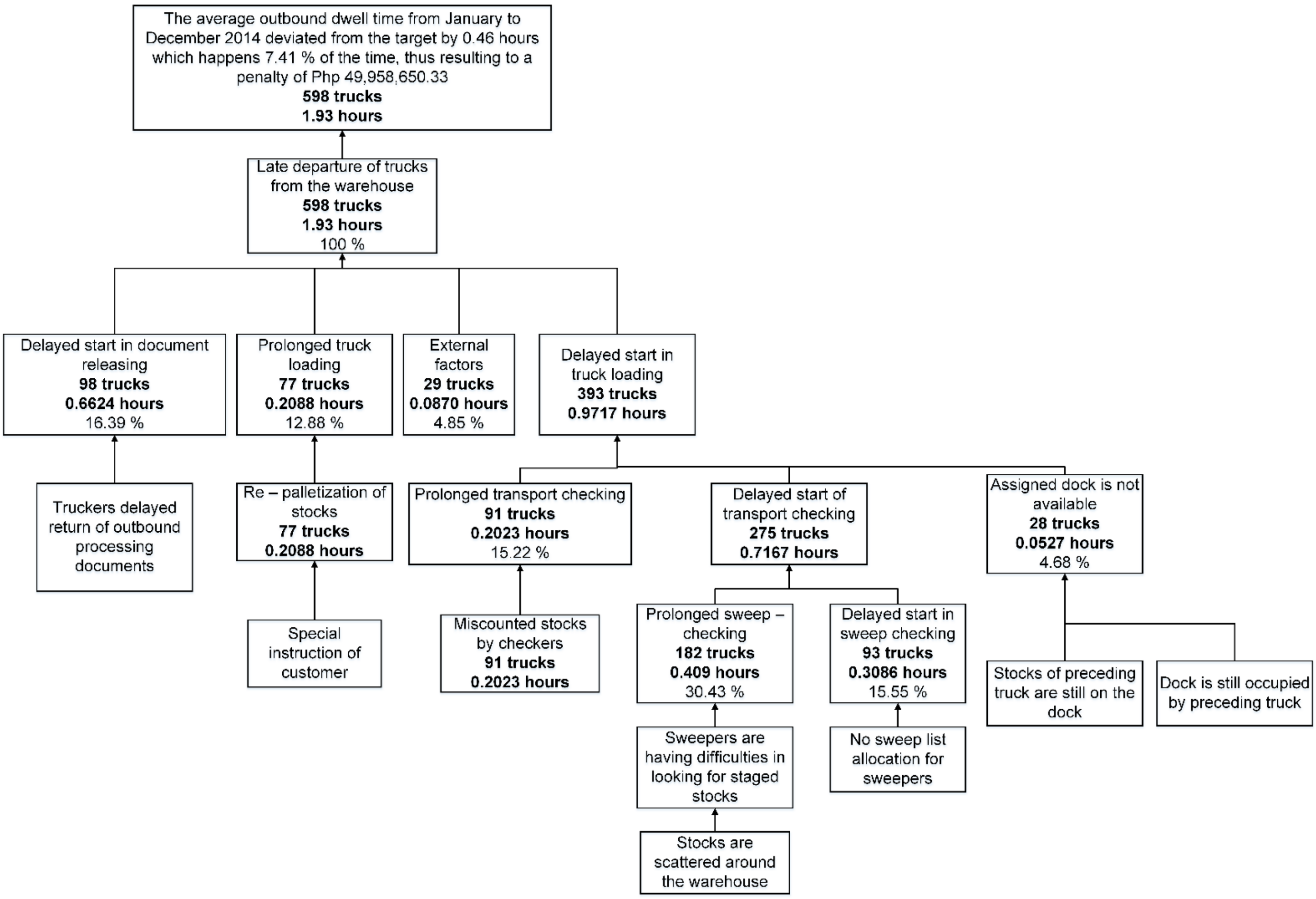

Figure 1: Final Why-Why diagram of problem causes

3.2.2 Delayed Start of Transport Checking

Sweep – checking, which is performed right before transport checking, refers to the transferring of stocks from inside the warehouse to the loading bay and checking of the completeness of stocks by the sweep checker. A delayed start in transport checking contributed 0.7167 hours to the delayed start in truck loading from the 2015 dispatch plan.

Prolonged sweep – checking

A prolonged sweep – check happens due to the difficulties that sweepers encounter in looking for stocks inside the warehouse. Unlike case picked stocks, the palletized stocks from warehouse 1 and 3 do not have an assigned staging area and are just left along the aisles. Hence, sweepers tend to check different stocks in different aisles until the correct stocks are found and swept. Prolonged sweep – checking contributed 0.409 hours to the delay in the start of transport checking.

Delayed start in sweep – checking

Sweep – checking begins when sweepers retrieve the sweep list from the outbound office. A delayed start in sweep - check happens because sweepers do not have a specific list assigned to them, which means that they would have to pass by the office to know if there are sweep lists available. But, sweepers from inside the warehouse are not informed that there are already available sweep lists in the office. Delayed start in sweep – checking contributed 0.3086 hours to the delay in the start of transport checking.

3.2.3 Assigned Dock Still Not Available

Delays in the start of truck loading would occur whenever a truck could not be accommodated because the bay or dock assigned by the dock allocator is still occupied, or if the truck before it still has not arrived. Hence, the truck is forced to wait for the preceding truck to arrive, finish loading, or to be released. Unavailable docks contributed 0.0527 hours to the delay in the start of truck loading.

Stocks of preceding truck are still on the dock

Truck loading cannot start unless the truck is already positioned in its assigned dock. However, there are instances in which the preceding truck has failed to arrive at the DC, resulting to its stocks being left at the loading bay. The presence of the other truck's stocks at the dock forces the dock allocator to re – assign the truck somewhere else, thus modifying the sweep – check endpoints, and delaying the start of its checking and loading processes.

Dock is still occupied by preceding truck

Truck loading also cannot start whenever the preceding truck assigned to the dock is still there. As a result, there are instances wherein the trucks have a delayed start in their activities because of the need to wait for the preceding truck to finish its operations.

3.3 Prolonged Truck Loading

Truck loading is prolonged when there are events during the process that require or bring about a stop or disruption in the loading of stocks. Prolonged truck loading contributed 0.2088 hours the outbound trucks' dwell time deviation.

Re-palletization of stocks

Re-palletization of stocks is performed during truck loading for some customers with special requests. Special of customers for re-palletization include changing pallet color, removal of slip sheet and changing of stacking height. Since these are performed during truck loading, loading exceeds its standard time.

3.4 Delayed Start in Document Releasing

After truck loading, the trucker must submit the documents to the office immediately to proceed with the releasing processes. A delayed start in document releasing, pertains to when truckers do not submit the documents immediately after loading. This has contributed 0.6624 hours to the late departure of trucks

Trucker's delayed return of processing documents

The documentation and releasing of pertinent documents is crucial for outgoing truck deliveries since these said documents are going to be presented to the receiving end. Upon loading, truckers are required to proceed to the outbound releasing office immediately in order to have their documents processed. However, there are instances in which truckers proceed to the canteen to take a break first instead of immediately submitting the documents to the office first.

4. Solution Design

The overall objective of the study is to meet the target dwell time. A new target dwell time of **4 hours** has been approved by the management. Other objectives include the following:

- Accomplish processes handled by the DC within their respective standard times
- Accomplish all processes involving the trucker within their respective standard times
- Reduce or eliminate unnecessary processes contributing to the delays occurring

Each of the final solutions address one or more cause/s of delays and meets the Musts and Wants approved by the DC management. The final solutions can be seen in Table 3.

Table 3: Final solutions

Cause to be Addressed	Final Solution	Processes Affected
Prolonged Sweep-Checking	Assign a new staging area and introduce reach truck sweeping functions	Retrieval Sweep-Check
Delayed Start in Sweep-Checking	Implement the use of barcode scanners in sweep checking	Transfer Order Creation Sweep-Check
Prolonged Transport Checking	Assign consolidators to revise the case arrangement on the pallets	Transfer Order Creation Sweep-Check Transport Checking
Delayed Start of Document Releasing	Assign a loading bay document runner	Document Releasing
Prolonged Truck Loading	Install stationary pallet changer	Transfer Order Creation Retrieval Loading
Assigned Dock is Not Available	Modify sequence of sweep-check and truck positioning	Sweep-Check Loading

4.1 Assign new staging area and introduce new reach truck sweeping functions

In the current retrieval process, the pallets are left in various staging areas (which are the aisles) in the warehouse. Assigning a specific location for temporary staging before actual staging on the loading bay was proposed (Yu & Egbelu, 2008). These aisle locations however are not labelled and cannot be seen in the sweeplists. By assigning a new fixed staging area, the sweep - checkers will have an easier time locating the pallets. Additionally, reach truck operators will now have to sweep the stocks to the new staging area after retrieval instead of just leaving the pallets and stocks along the aisle.

4.2 Implement use of barcode scanners in sweep - checking

In the current set - up, the sweep – checkers are the only ones in the warehouse who do not use barcode scanners, but use a physical sweeplist from the office. As a result, there is a delay when they are not informed of available checklists, and a delay in retrieving and returning the sweeplist. According to Nee (2009), an integration of the barcoding system in all warehousing processes would yield to better management and tracking of processes. Implementing the use of the barcode scanners for sweep – checkers will speed up the process by reflecting the sweeplist with the location of the stocks from the new staging area on the scanner. Moreover, this will also remove the need to retrieve and return documents, and will promptly inform sweep – checkers of any pending sweeping activities.

4.3 Assign consolidators to revise case arrangement on pallets

In the current case picking operations, a consolidator just makes sure that stocks under the same order/truck are located in the same staging lane before these are swept. With the current process, truckers tend to miscount stocks during transport checking since some cases of the same SKU are located in different pallets. The trucker must go around the loading bay and search different pallets just to find the stocks under the same SKU. According to Bartholdi and Hackman (2005) 'travel time is waste. It costs labour hours but does not add value'. By assigning consolidators to revise the case arrangement, the transfer order creation will be affected. SKUs in the new sweeplist are now batched and will indicate which cases will be placed together in the same pallet. Consolidators will now follow the case arrangement printed in the list. Transport checking will now be easier and faster for the trucker since excess travel time to locate the stocks of the same SKU in different pallets will be eliminated.

4.4 Install stationary pallet changer

Currently, re-palletization of stocks based on special requests of some customers are performed during truck loading. Re-palletization is currently being performed manually by the truckers which also prolongs loading. Installing a stationary pallet changer will speed up re-palletization. Additionally, with the implementation of the pallet changer, re-palletization will now be performed during retrieval. This will not affect the dwell time since retrieval is performed a day before the truck arrives.

4.5 Assign a loading bay document runner

After loading, the start of document releasing do not start immediately since truckers tend to proceed to the canteen first with the documents for their break instead of submitting these to the office first. By assigning a loading bay document runner, the truckers will now submit the documents to the runner patrolling the loading bays. The runner will be the one to submit the documents to the office to begin the document releasing processes immediately.

4.6 Modify sequence of sweep - check and truck loading

Currently, the stocks are swept to the loading bay first before the truck arrives and positions in its designated dock. Under this set - up, the possibility of a truck's late or non - arrival may lead to delays in its succeeding truck's activities. By modifying the sequence of sweep - check and loading, sweep - checking starts once the truck starts to position at its assigned dock so the loading bay occupancy time will be reduced (Boysen et al., 2010). After the truck positioning, the trucker proceeds to the Transport Office to obtain the documents needed for trucker checking and loading. The trucker goes back to his assigned dock in the loading bay and proceeds to check the stocks once the first batch is already swept. Sweep - checking and transport checking will now overlap.

5. Validation

The work sampling data from the proposed solutions addressing specific problems were evaluated against the current standard process times and the projected changes in the duration and sequence of the tasks involved. The following table shows the improvement of each process that was considered.

Table 4: Summary of Old and New Process Times

Process	Current	Proposed
Retrieval	2.746 mins.	3.47 mins.
Retrieval with Re-palletization	2.746 mins.	9.47 mins.
Sweep-Check	47.26 mins.	26.47 mins.
Transport Checking	46.86 mins.	36.59 mins.
Manual Loading - Canter	33.56 mins.	29.78 mins.

Table 5: Summary of Old and New Process Times

Process	Current	Proposed
Manual Loading – L300	12.74 mins.	8.96 mins.
Manual Loading – Wingvan	52.64 mins.	48.86 mins.
Push-Pull Loading-Wingvan	30.10 mins.	26.32 mins.
Push-Pull Loading-Container	46.67 mins.	42.89 mins.
Palletized Loading-Wingvan	30.38 mins.	26..60 mins.

5.1. Capacity and Dwell Time Improvement

Aside from the changes in the process times, improvements in the outbound warehouse capacity and in the truck dwell time were also realized when implementing the solutions. Although the bottleneck process (sweep – checking) remains the same, the warehouse capacity increased from 151 trucks per day to 270 trucks, or a 44.07 % improvement. Since there were reductions in the process times and a modification in process sequences, the new outbound dwell time resulted to only 2.11 hours. This has made it possible to reach the new target outbound dwell time of 4 hours.

5.2. Simulation

After evaluation of the process times, the new processes and modified sequences were incorporated in the warehouse dispatch plan to validate if the proposed objectives could be achieved. Two validation procedures were used to assess the improvement of the proposed system, with the first using the constant process times, while the second run with a conservative scenario wherein the respective standard deviations of the old process times were added to the new process times. Table 5 shows the result of the simulation with a target hit rate of 82.5% for meeting the Target Dwell Time (TDT).

Table 6. Summary of Validation

	Current	Constant	Conservative
Target Dwell Time	3 hrs.	4 hrs.	4 hrs.
Ave. Dwell Time	4.93 hrs.	1.665 hrs.	4.38 hrs.
Trucks missing TDT	598	158	205
Trucks meeting TDT	380	820	773

Table 7. Summary of Validation

	Current	Constant	Conservative
% Hit	38.85%	83.84%	79.04%
Improvement	-	53.66 %	50.85 %

Based on the simulation, there would be a 53.66 % improvement in the hit rate under the constant times run, while there is a 50.85% improvement for the conservative times run.

5.3. Cost benefit Analysis

The cost analysis considers a 10 – year study period of the proposed system. This includes the immediate implementation costs, acquisition and installation of equipment, and recurring costs. As required by the proposed solutions, additional barcode scanners, a pallet changer, and other supporting materials are to be purchased for successful implementation. The barcode scanners, which will be used by sweep-checkers, amounts to Php 1.855 million, including the installation and integration to the current barcode system that the DC already has. Additionally, the stationary pallet changer to be used in re-palletization also requires importation and freight costs, all summing up to Php 5,508,500. Lastly, all additional materials such as signages for the staging area, barcode location tags and protector amounts to Php 100,500. Overall, the immediate implementation costs amount to Php 7,464,000. Recurring costs in terms of equipment maintenance is considered and amounted to Php 300,000 per month.

The benefit that the proposed system would give are savings in the penalty contribution of the prolonged dwell time to the timeliness of deliveries. From the 598 trucks that missed the dwell time, the benefit was derived from the number of trucks that the proposed solutions were able to save from missing both its dwell time target and delivery date. In order to quantify this benefit, the number of trucks that missed the target dwell time was obtained from each simulation run. These values are then subtracted from the number of trucks from the current system performance (with 598 trucks missing the TDT) in order to get the number that were able to meet the dwell time. Since the penalty associated with dwell time is its contribution to the delivery timeliness, the number of trucks that met its delivery time and date were taken (the DC's current performance on on – time delivery is at 77.62 %). This is visually shown in Figure 2, for the constant process times.

Using the calculation in Figure 2, the number of trucks that hit the delivery dates is 341 for the constant run and 305 for the conservative run. With the September 6-12, 2015 invoice value considered per truck, the total invoice price was calculated per run, wherein 3% is the supposed penalty.

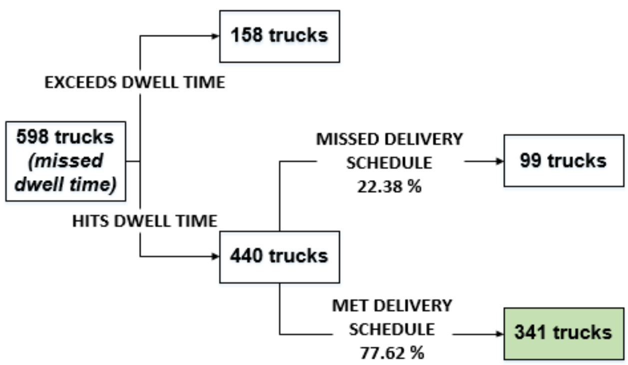

Figure 2: Trucks that hit TDT and OTD

The benefit for the proposed solution under the constant run amounted to Php 5,925,612 while the benefit under the conservative run amounted to Php 4,906,209 per week. To get the savings per month, the savings per week must be multiplied by 4 (weeks). Moreover, the implementation costs of the solution will be recovered in 0.3189 months.

6. Conclusion

Based on the simulation runs, implementing the recommended solutions would yield to significant changes in the process times, truck dwell times, and the overall outbound warehouse capacity. These solutions involved process element and sequence modification, an introduction of barcoding and a new machine in certain processes, and new personnel roles. Implementing this would yield to a 83.84 % hit rate for a constant value run, and a 79.04 % hit rate for a conservative setting.

Subsequently, the calculated improvement of the warehouse capacity with the proposed system results to a 44% increase from 151 trucks served in the current system to 270 trucks from the proposed. Improvement on the outbound dwell time was also calculated against the standard processing time evaluated from the proposed system. From a work sampling data of 4.93 hours, the outbound dwell time now amounts to 2.11 hours on the average. Finally, a total net benefit of Php 23,402,448 per month is expected from the implementation of the proposed system.

Recommendations

The researchers recommend the following methods in order to achieve a more refined analysis and study of the distribution center operations:

1. An actual implementation of the proposed system. To gather actual analysis of results, a partial or full application of the proposed system could be done with the management of the DC in order to obtain actual results from the study. Furthermore, failure points and other systematic concerns can be addressed in the implementation period to further support the proposed solution and the DC operations.
2. The consideration of office procedures and how it is streamlined in a customer order. The focus of the study heavily centers on the physical activities that occur in the DC. Thus, delay points in the processing of orders in the office operations might have been omitted.
3. A monthly dispatch plan analysis. In this study, only a week's worth of deliveries was considered. A broader study on a month's dispatch plan would add to more data and may uncover more root causes for the problem analysis and further improvements in the validation of solution.
4. A further study on the warehouse system integration's use of RFID to realize better benefits. The item-tagging

mechanism as used in the printing industry may be similarly used for SKU identification and movement as suggested by Hou & Huang (2006).

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