

# Inventory Management of Dimensional Lumber: Preventing the Loss of Current and Potential Future Revenues

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**Abstract—** In any commodity market, such as dimensional lumber, every effort must be made to reduce the loss of current and potential future revenues. TMO Global Logistics (TMO) has commissioned a research project for the University of Virginia (UVA) which emphasizes the need to design a solution that adds value and minimizes these losses. The loss of revenues, both current and future, associated with dimensional lumber arise for two reasons. The first of these is the loss of lumber in the transit from the mill to the final destination of the customer. The second is the deterioration of lumber while at the discharge port. Through a study of the concept of operations for the current system, this paper identifies the causes of the revenue losses. A feasibility and economic study of proposed alternative solutions to properly rectify these issues has resulted in the recommendation that TMO implement barcode scanning of all packages to prevent the loss of lumber and implement a commodity code to improve the handling of the material at the port. In order to prevent the deterioration of lumber due to the ambient conditions, it is recommended that TMO store the lumber inside of a warehouse immediately upon discharge.

## I. INTRODUCTION

The loss of revenues, both current and future, associated with dimensional lumber arise for two reasons. The first of these is the loss of lumber in the transit from the mill to the final destination of the customer. The second is the deterioration of lumber while at the discharge port. This Senior Thesis Capstone Project identifies the sources of these two issues through an analysis of the concept of operation for both the transit and the port operation. Also included in this report is a study of the alternatives to the current method. Through a conceptual and economic study an alternative has been selected and an implementation plan is offered for each selected alternative.

One of the issues that constantly arises in the transportation of dimensional lumber through an ocean voyage is the loss of material that one party claims was discharged off of the vessel and another party claims was not. Dimensional Lumber is defined as “sawed lumber from 2 to 5 in. (5 to 12.7 cm) thick and from 4 to 12 in. (10.2 to 30.5 cm) wide” [1]. The length of this material varies as producers will cut and bind the lumber to achieve the specific lengths required by their customers. The loss of these packages of lumber, which range in cost from \$250.00 to \$1100.00 [2], results in a large number of monetary claims that “require approximately 2080 man hours and other resources for [my client] to research, negotiate, and settle”. (T Alexander, personal communication, September 26, 2006)

There are also substantial costs of time and money associated with discharging material from the vessels to the final place of rest. These include the cost of docking the vessel, operation of the cranes, forklifts fitted with special lumber forks, flatbed trucks, and the crew (gangs) that operate the equipment. There are also cases in which the material is moved around the port, between warehouses and other lumber yards, and may be misplaced and or damaged. For these reasons, there is need for an analysis of the inventory management systems that tracks the inventory at each step of the process, along with damage notation at each step. Through the use of the IMCIS (Inventory Management, Control, and Information System), they will be able to reduce the port operation costs by eliminating some of the labor requirements and making the sorting of material more efficient.

The second issue that arises when dealing with the transportation of dimensional lumber is the deterioration of the lumber on route to the final location of the “receiver.” The Receiver is defined as the company to whom the lumber is sold. This has resulted not only in claims, which in turn result in lower profit margins, but is a detriment to the reputation of the lumber producers which pride themselves on the quality of the lumber they sell. This deterioration occurs for two reasons. The first of these is the length of time in which the material stays in port. The second is the plastic wrap which is not suitable for the conditions it is exposed to, for the periods of time that the bundles of lumber are outside. “The [plastic] wrap that was used [to package the lumber] is not suited for lumber and is far too brittle to stay on the units without breaking away from the fasteners.” (Bob Arruda, personal correspondence, March 6, 2007)

## II. RECORDING INVENTORY TO PREVENT LOSSES

### A. Hand Count

First, let us begin by describing the process for recording inventory as it first arrives at the load port in Germany, is loaded onto the vessel, transported across its ocean voyage, and finally as it reaches its destination port on the United States east coast (USEC). The process begins with an order for a certain amount of lumber, with varying dimensions, grades and species. This order is processed by the mills in Germany and the lumber is produced at one of several mills. Once the packages of lumber are made, four labels containing a unique alpha numeric pack number and a barcode are generated by an SAP® program for each package. These labels are then applied to the lumber as the

package is being wrapped by the plastic lumber wrap. The packages are then loaded to a rail car which will be sent from the mill to the load port. The pack numbers from the packages loaded to each rail car are recorded along with the corresponding rail car number and sent via an electronic data interchange (EDI) transfer to the load port.

When the material arrives at the load port, it is unloaded and hand tallied against the EDI transfer list and placed into a shed or other place of storage. The material is stored at that location until the vessel arrives and is ready to have the material loaded into the holds. At this time, the material is moved to the side of the vessel where it is again hand tallied and the vessel's captain along with an employee of the load port sign off on the "mate's receipt". This document states the quantities along with the condition of the cargo being loaded onboard. From the mate's receipts along with other mill records, a packing list is created which shows the breakdown of packages, by dimension, by port.

The material then makes the ocean voyage to one of the discharge ports on the USEC. At the discharge port, the material is unloaded from the vessel and is taken to the "final place of rest". At this point the material is once again tallied and this final tally, called the Over, Short and Damaged (OS&D), is sent to TMO for reconciliation with the packing list. "Depending on the quantity of packages and the duration of the load or discharge, the tallying of material requires at least one separate employee, sometimes more." (Todd Alexander, personal interview).

There are several issues associated with the hand counting of material. The first of these is human error. Human error in this case can be thought of as forgetfulness and/or inattention. At a discharge port where a single employee is responsible for counting 3000+ packages of lumber while there are many other noisy transactions occurring, the employee may be distracted while a forklift passes by and miscount the number of packages. Other factors that lead to the human error element include; sunlight, inclement weather, and the distance from packages while counting, all of which affects the visibility of the labels that the counter has. These factors all lead to OS&D reports which many times are not reliable.

Due to the lack of reliability in these reports, each report must be carefully reconciled before being disclosed to the customer. This reconciliation requires a large investment in "man hours, and other resources to research, negotiate, and settle" (T Alexander, personal communication, September 26, 2006). Another bi-product of the unreliability of the reports is that a full physical inventory must be performed every quarter basis the TMO Best Practices. This is to ensure that the sales agents have correct information regarding the inventory levels they have at the port locations. The average inventory report requires a full day for two employees in order to count and reconcile the discrepancies in inventory counts. As you can imagine, when you multiply this by 13 port locations, this quickly becomes a very time demanding position.

## *B. Scan Barcode*

Printed on each package label is a barcode which contains information corresponding to that specific package. This information includes the dimensions of the package, the shipper and receiver, the discharge port, and the grade of the product, all key pieces of the packs identity essential to properly managing the pack throughout the entire supply chain. Currently there are two ports, North Carolina State Port Authority and Ambassador Services Inc., which scan these barcodes as their means of receiving the package from the vessel. Though neither port uses this system exclusively, they have been able to identify the pros and cons of using this system.

The concept of operations for the bar-coding system does not require a major change in the way that the entire supply chain operates but does however affect the roles that each entity plays, and the speed at which information can flow throughout the system. The initial input of information corresponding to the packages would be at the mill when the unique pack numbers are created. When the packages of lumber arrive at the load port, instead of hand counting the material when it is placed in storage, the material would need to be scanned using a barcode scanner. This information would then be batch uploaded to an inventory management system called IMCIS (Inventory Management, Control & Information System). When the material is then ready to be loaded to the vessel it is then scanned again and assigned to that vessel. The package is now under the "ownership" of the vessel. When this batch upload occurs it triggers the creation of the documents needed by each discharge port to plan the yard and also creates an incoming inventory document that the sales agents can utilize to begin to sell the material even before it arrives. Because the information corresponding to the unique package number is already stored in the IMCIS database, there is no need to record this information more than one time. After the ocean voyage, the packages are then discharged and are scanned at a scanning station before reaching the final place of rest. This scan transfers the "ownership" of the cargo to the discharge port from the vessel. When this batch upload occurs, different documents are created than the first set of uploads. This time the OS&D report is created and sent to TMO automatically instead of the normal turnaround time of around 48 hours. Also a listing is sent to the sales agents notifying them that the packages have landed and the inland distribution leg of the supply chain can be started.

During inland distribution, when the packages are sent by truck or rail to the final receiver, a document called a delivery order is sent from the sales agent back to TMO. This document contains information regarding the dimensions of the packages, the quantities, and where the packages need to arrive. This document could be created automatically using the IMCIS system by selecting these packages from the inventory in IMCIS and assigning them to a receiver. This would send an automatic message to TMO with all of the information laid out in the required format and would also send a message to the final receiver notifying them that the material is in transit.

One of the major flaws of the current system is the speed of the information flow. Documents must be created at each leg of the supply chain and the information for these documents is dependent on the information from the preceding leg. IMCIS and bar-coding solve this issue in that all of the information is available to all entities in the supply chain from the beginning of the process. The instant that a package receives its unique pack number and location, all of the information regarding the dimension and final receiver is stored in the database. This information is readily available to discharge ports to aid in the planning of the yard, to the sales agents for selling and pricing strategies, and to TMO for logistical planning both on the ocean voyage and on the inland distribution.

For a bar-coding system to fully replace the current null alternative would require an overhaul in the way that the information received from these scans is utilized. The greatest roadblock in the system is that each stakeholder in the system has their own separate inventory count that they maintain. This includes the inventory counts that the mill maintains, the 13 ports each maintain a separate inventory, and also the sales agents maintain a separate inventory. "Unless we got all of the [inventories] lined up we knew that both [the mill] and [the sales Agent] would not use IMCIS. They would use the inventories they keep on their computer only." (Chris Ball, Personal Communication, August 30, 2006)

### C. Commodity Code

One of the issues that contribute to human error in the recording of the inventory as it is being received from the vessel is the label placed on the package. Currently this label notes the dimension of the package, the unique package number, grade, species and the barcode. The problem with this label is the way that the port yard is planned in order to segregate the material. The yard is segregated by shipper, receiver, dimension, grade and species. All of these things, except for receiver, are noted on the current pack label and the receiver can be found by looking at the stowage plan but the issue lies in the fact that this information is too small for forklift drivers to see from a significant distance.

A new packing-label has been created which is double the size of the label currently in use and therefore allows for larger printing and making it easier to be read from the fork-lift. This new label will have an alpha numeric commodity code which includes the customer, the dimension and the quality. The new label should replace all the other labels and markings we put on the pack right now. The code will be stored in TMO's computer-system and updated regularly by TMO employees. The code is standardized for all material thus eliminating a great deal of confusion regarding what the markings mean at different locations.

The visual angle of the forklift driver was found by taking the height of the forklift seat, 3ft, the eye height of the average driver 31 inches, the height of the pack, 3ft, the distance between the driver on the forklift and the pack, when the driver needs to first recognize the pack, 50 ft and

inputting those numbers into the formula for visual angle. ( $VA = \arctan(H/D)$ ). This was then completed for each pack that will be picked up by the forklift, anywhere from 2-4 packs in order to tell us where to place the stickers on the packages. The visual acuity was then found using the Snellen Acuity to tell us what size the letters needed to be.

One of the major concerns regarding this system is the requirement on the forklift drivers to learn a new system. The code has been designed to be simple for the fork lift operators and tally clerks to learn and to recognize while on the dock. The first set of marks identifies the receiver and therefore dictates which yard the material goes into. The second set of marks identifies the dimension, grade and species and therefore dictates in which stack the material is stowed.

### D. RFID System

RFID Technology has many potential applications in today's global supply chain management. "RFID increases productivity and convenience" [3] The development of radio frequency technology can be dated back to 1864 when James Clerk Maxwell concluded that electric and magnetic energy travel in transverse waves. [3] His theory on electromagnetic fields led to Heinrich Hertz's studying of electromagnetic waves. Through this research he was able to prove that these waves could be "reflected, refracted, and polarized like light." [3] The development of this technology was slowed due to the need for advances in transistors, integrated circuits (IC), microprocessors, and communication networks. [3] The integrated circuits were essential to the development of RFID tags. A chip-based RFID tag is dependent on a silicon chip using an IC and an antenna. [4] Once these developments occurred the possibility of today's uses in RFID became a reality.

There are several types of RFID tags including passive, active, and semi-active (semi-passive) which all come in varying sizes. Passive tags obtain their name from the fact that they have no internal power supply. That means for the majority of the life of the tag it is passive. "The minute electrical current induced in the antenna by the incoming radio frequency signal provides just enough power for the ... integrated circuit (IC) in the tag to power up and transmit a response." [4] The way that the majority of the passive tags are "read" is by backscattering the signal from the reader. Some of the major advantages to passive tags are that they "do not require batteries, can be much smaller, and have an unlimited life span." [4] Because passive tags do not need to have a battery in the actual tag, it opens up the production of the tags to multiple materials. One of these materials is polymer. "If successfully commercialized, polymer tags will be roll printable... and much less expensive than silicon-based tags." [4] Active tags have their own internal power supply, are typically more reliable than passive tags, because they can conduct a session with the reader, and transmit at higher power levels than passive tags. [4]

One of the most important factors in deciding on an RFID solution is deciding if you want your vendor to provide an end-to-end, all of the components of the system, or if you want to select different vendors for each component. In

considering using different vendors, the interoperability of the components is very important. Global standards ensure that there are “incentives for companies to implement RFID solutions broadly, and for developers to create innovative RFID technology.” [5] “Global standards are still being worked on” [6] but the two leading standards are EPCglobal and ISO. The standards deal with such issues as; reader protocol, middleware specification, physical markup language (PML) core specification, and extensible markup language (XML) schema and instance files, and object name service. These allow you to buy a product from one vendor and integrate it with another product without worrying about the compatibility of the technologies.

The compatibility of any system is greatly enhanced by global standards set by standards organizations. Through discussions with vendors, EPCGlobal stood out as the standards organization that had the greatest potential to be accepted industry wide. “EPCglobal is leading the development of industry-driven standards for the Electronic Product Code™ (EPC) to support the use of Radio Frequency Identification (RFID) in today’s fast-moving, information rich, trading networks.” [13] Through an analysis of the concept of operation, a passive tag solution was decided on basis the lapse of time between scans and also the type of information needing to be stored on the RFID tag. The standard that covers a passive tag system under EPCGlobal is “commonly known as the “Gen 2” standard. This standard defines the physical and logical requirements for a passive-backscatter, Interrogator-talks-first (ITF), radio-frequency identification (RFID) system operating in the 860 MHz - 960 MHz frequency range. The system comprises Interrogators (also known as Readers), and Tags (also known as Labels).” [14] Once the knowledge of the standard was attained, the search for a RFID system solution was narrowed. Basis the cost per tag, \$0.34, the CCL Label company’s Rafsec UHF Gen 2 p/n 3000825 tag was selected. Other tag types were considered such as an RFID Nail, but given the fact that the nail would need to be inserted into the lumber and the safety concerns associated with that, the client asked to move the project in a different direction. Given a tag and a known frequency range, a Reader was the next object to be selected.

In the port management of dimensional lumber, the only way to move these massive packages, which can weigh over 3000 lbs, is to utilize a forklift. LXE has designed a RFID Reader which is mounted between the lift’s forks, Image 2 below. This placement allows the reader to be close to packages, protected against shock and conveniently installed. LXE’s RX2 Forklift RFID Reader was chosen for implementation into this project as it complies with the Gen2 tags selected previously. In order for the forklift mounted reader to perform to its full capabilities, it must give the forklift driver instantaneous feedback. This is made possible by having a vehicle mounted computer with a display that notifies the driver of the specifications of the packages they have just picked up. LXE’s VX6 vehicle mount computer is designed for this purpose, Image 3 below. It offers the driver a viewing area along with large buttons that can easily be pushed easily with gloves on. It is powered by an internal

battery, runs on a Window CE .NET operating system and has multiple mount positions to fit the functionality of the forklift.

There are many pros to the use of an RFID system, including increased productivity, convenience, improved data collection, and eliminating a human element from the inventory process. There are also several cons which make the system not feasible at this time. The first of which is the implementation cost. In order to fully implement an RFID system of this scale would require a three year investment approximated at \$972,300 before the system’s returns equaled its expenses. This break even cost comes with great uncertainty stemming from the lack of a clear global standard. A second con to the implementation of a system of this scale is the lack of clear data relating to maintenance costs and cost of the technology becoming obsolete. If you consider the technology that was present three years ago and make predictions about where the technology will be in three years, the amount of time it will take for the system to break even, the chance is too large to take at the given costs.

I would not recommend this system until you can break even in one year’s time. For this system, basis the calculations in the Cost Benefit Analysis, this would be a total implementation cost of \$152,828 and first years operating cost of \$185,300 totaling a one year saving of \$338,128, which the system is calculated to provide.

### III. MANAGING INVENTORY TO PREVENT THE DETERIORATION OF LUMBER

Recently the complaints by the receivers of dimensional lumber have increased due to the poor quality of the lumber when it arrives at their final location. This has resulted not only in claims, which in turn result in lower profit margins, but is a detriment to the reputation of the lumber producers which pride themselves on the quality of the lumber it sells. Through an analysis of the system it has been found that the quality of the lumber has been decreased by two separate issues.

The first of these is the length of time that the material has been in port. The current state of the lumber market is down and in this down market it has become increasingly difficult for the sales agents of the lumber producers to sell the lumber in the times that they could previously. We’ve found that the damage to the quality of the lumber seems to begin to occur around the 3 month mark of being at the discharge terminal. In some circumstances, bundles are being left at the port for 6+ months due to slow sales. Although TMO has mandated to the ports that they follow first in first out (FIFO) for their clients, situations have arisen in which the port was instructed by the sales agents to ship only “good material.” This has only worsened the situation by increasing the time that already deteriorating lumber sits at the port. When this material finally does ship it is so damaged that the receiver files a claim.

The second issue, and the purpose of this document, is the plastic wrap which is not suitable for the conditions it is exposed to for the periods of time that they are outside. Once the plastic wrap gets ripped, even in the slightest, the size of the hole is exacerbated by

environmental conditions such as wind, rain, and the salt that is in the air due to the proximity to the ocean. This opens the possibility for sun damage and moisture damage. Even in the cases where the wrap does not tear, the humidity from the port region is trapped under the plastic wrap, because the wrap is not breathable, which leads to mold and moisture damage. These issues are enhanced by the fact that the material is at the terminal for such long periods of time.

The current solution to the problem has been to re-wrap the lumber as is necessary. This puts a responsibility on the port that they are not willing to take. As part of the TMO Best Practices the port locations are required to re-wrap the few bundles that come off of the vessel and have torn wrappers or missing bands but they continually push back when it comes to re-wrapping entire stacks of bundles that have been sitting at the port for months and have deteriorated, not due to their negligence, but due to the duration of time they are on the ground.

The solution of re-wrapping is also not a viable solution as many times the lumber has been exposed for too long to the elements and the deterioration has already occurred to the lumber. If this is true then the lumber producers' images are hurt even more by the issue of customers receiving lumber in clean, new packaging while the material beneath is worn and/or moldy. This deception can only hurt the producers, it certainly does not help. These companies could pay to have the lumber cleaned but this is adding an even greater cost and taking more away from the bottom line for each bundle of lumber. Re-wrapping the current lot of deteriorated lumber will not be the most cost effective alternative for the lumber producers as the ability to sell these packages for a cost above their break even costs is hurt by the slow market as well as the fact that the majority of the damaged packages are of dimensions that traditionally move slower.

#### A. Improve Wrap Quality

The current wrap solution on the material being shipped to the USEC is not holding up to the environmental conditions, especially in the gulf region. An alternative to the single layer wrap was investigated and the use of a double layer wrap was the main focus of the investigation. The top layer is similar to the plastic wrap that the lumber producer uses currently but has UV protection. The bottom layer contains a black plastic wrap which acts as a mold inhibitor. This solution serves to stop the deterioration of the lumber by adding another layer of protection along with the UV protection and Mold Inhibitor which are both missing from the current plastic wrap while remaining cheaper than the poly-woven solution which is used for Home Center material.

MultiSac® creates a line of lumber wraps called Plastex® which is meant for the protection of kiln dried lumber. Plastex® is a fabric which contains “agents to protect against ultraviolet degradation”. [15] It is not woven which will keep costs down while preventing the brittleness of the wrapper which occurs due to UV damage. This brittleness is often what encourages the initial hole in the wrapper. This hole then becomes susceptible to wind

damage which can enlarge the hole and allows in moisture which can lead to mold on the wood.

#### B. Decrease Duration at Destination Port

Given that the plastic wrap currently in use holds for around 3 months, if the sales agents were able to sell all of the material being discharged off of any given vessel within 3 months after the vessel completes discharge, the current wrap solution could protect the lumber. This would lead to no new costs regarding packaging of the lumber, and would alleviate the losses to the profits on lumber sales due to the deterioration of the quality of the lumber.

In order to facilitate the decreased duration at the port, a Just in Time inventory strategy was researched. There are several limitations with a traditional just in time management strategy because of the nature of the industry in which the product is in. Dimensional lumber is a commodity which many times goes towards the production of homes and other home repair products. This means that the strength of the industry is largely dependent on the Housing Starts, or the number of privately owned new homes that have been started over some period of time. This period is reported by the US Census Bureau on a quarterly basis. The market can have large peaks and low valleys that vary almost weekly.

$$Q = \sqrt{\frac{2 * K * D}{kc}}$$

#### Economic Order Quantity (EOQ) Formula

To account for this the data used for the inventory forecasts should be restricted to a shorter amount of time. The typical order for lumber, from the placement of the order to the time that the lumber is received at its final destination can be completed in 4 weeks, dependant on the size of the order and the final destination of the lumber. Given this average lead time, you can optimize your order size, Q, by limiting the other variables in the Just in Time formula to a 4 week cycle as opposed to the yearly cycle used in many other industries. K, the incremental cost of placing an order, does not change depending on the length of the period, but KC, annual cost of carry one item of inventory, should be limited to 4 weeks, as well as TC, total cost over the year. Most importantly, D, annual demand in units, should be predicted by analyzing the demand, by dimension, over the past 4 week cycle.

#### C. Tarp Lumber at Destination Port

Tarping the bundles of lumber as soon as they complete discharge will alleviate the need to make changes to the current wrapping as it will serve as an extra layer of protection against the elements that deteriorate the current wrap. The proposed tarping solution would be laid on top of the stacks and would run the entire volume (L x W x H) of the stacks and will then be anchored to the ground around the stacks. There are several benefits of the proposed tarp solution which include; water resistant, mildew resistant, tear resistant, acid resistant, heavy duty poly tarp, artic flexibility, and it is UV treated on both sides. In order to cover a typical stack that is 6 bundles high by 27 bundles long, one would need a tarp that has been calculated to require a size of 50' x 150'. The cost of this would be

\$356.25 and this cost would decrease as you decrease the size of the tarp (e.g. 30' x 50' = \$71.25). This will allow the ports to buy, or be provided tarps of differing sizes to match the size of the stacks and account for the depletion of the inventory. There will be labor costs involved with this as this would require additional time and man power for port personnel. These costs cannot be currently predicted due to the consideration that no port has ever tried to tarp an inventory this large.

#### D. Inside Storage at Destination Port

As previously demonstrated, the reasons that the current dimensional lumber wrap deteriorates are external. One solution to these problems is to remove the possibility of their occurrence. By placing the lumber directly inside after discharge, the lumber producers do not take on any extra charges on changing the wrap, changing their inventory system or tarping the lumber. They do however take on extra charges that occur in the discrepancy between inside storage rates and outside storage rate. These will need to be evaluated on a case by case basis as there are sometimes large discrepancies in these two rate and sometimes none at all.

The way that dimensional lumber is currently segregated at the port is by dimension, grade, species, and vessel. These segregations sometimes require vast amounts of space which, depending on the port location, can sometimes not be feasible for the amount of space indoors. In order to account for this lack of space, ports would be required to make decisions as to which segregations they will make. The major downfalls to this are the ability to circulate the material FIFO and the increased possibility of sending out the wrong material. The first issue becomes less important now that the material is no longer exposed to the possibility of deterioration. It will however affect the accuracy of the storage invoices you receive for the material left in port. The second issue poses a much larger problem in that there are substantial costs with trucking the wrong material out of port. There are handling and un-handling charges, trucking costs, and the most detrimental to TMO as the logistics professionals, complaints by the receivers of the material

#### IV. CONCLUSION

Basis the cost benefit analysis of the RFID system and the IMCIS system, it is recommended that TMO utilize the IMCIS system for the recording of inventory. The implementation costs for the IMCIS system are much smaller than that of the RFID system. Also the break even time and costs are much cheaper than that of the RFID system. In a comparison of functionality, both barcode scanning and RFID scanning have a successful scan rate of about 95% which means that RFID has no clear advantage unless the speed of the throughput increases its value. For this system, the throughput is not fast enough as the users of the system only gain about 5 seconds per RFID scan versus an IMCIS barcode scan.

The IMCIS system is currently being underutilized on the basis that, in order for the system to provide any value, all of

the ports as well as the sales agent must view this as the final inventory. Currently only two ports are utilizing IMCIS and neither are scanning outbound loads. In order to fully implement the IMCIS system, TMO should employ one of the two existing users to utilize the system for both inbound and outbound material. This minimizes the cost of implementation across the board while gives TMO a selling point if the port can use IMCIS to effectively manage their own inventory. Once they have the user data from the one port that decides to fully implement the system, they can then implement across all other port locations. Once the ports are fully implemented, the transition for the sales agents will be smoother as it will not lead to any misshipments on the behalf of the ports.

At the same time that TMO is implementing IMCIS they should implement the commodity code system. This system will make it easier for forklift drivers and tally clerks to record the packaged into inventory and to place it in the proper segregated stacks. A commodity code across all ports will make sure that material that is noted short or over in one port location can be easily identified as belonging to another port location on the OS&D report.

In order to mitigate the damaging effects of the external environment, TMO should store packages inside. This protects the packages from the effects of the sun, wind and rain. By doing this they can reduce the number of claims that are filed against them by the receivers of the cargo. This also allows them to retain the current wrap solution they employ and does not require the purchase of tarps or the labor that goes along with tarping the lumber. By placing the packs inside, it reduces some of the demand on the sales agents to sell the material quickly in this down market and will allow them to maintain their premium pricing levels.

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