Receiving Process Improvement Project

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Abstract - Receiving Process Improvement Project

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Problem Statement

This project examines the inefficiencies of a current receiving process of an offsite warehouse, which supports a manufacturing plant. The offsite warehouse's receiving process poses a problem for the Just in Time (JIT) strategy utilized by the manufacturing plant. If products are not processed in a timely fashion, to become available for the plants disposal, there is a possibility of a line down situation. A second existing challenge is a lack of available space for incoming deliveries to the warehouse when the receiving process is overloaded and backlogged. Another problem which must be avoided is having all temporary holding lanes full of products while additional deliveries are scheduled. This could force shipments and receiving to be delayed. In order for these undesirable situations to be avoided, the current process requires improvements in order to effectively support the volume of throughput required to sustain the needs of the manufacturing plant.

Methods and Procedures

Utilizing the Deming Cycle, an action plan was developed and implemented which addresses the concerns above. The action plan fostered accuracy in receiving, increased inventory visibility in computer systems, and timeliness in processing deliveries. The Deming Cycle provided a structure for the project to be shaped around. After a sustainable process is implemented, the warehouse will be able to efficiently support the needs of the manufacturing plant.

Summary of Results

A number of process changes implemented within this project resulted in numerous benefits. These changes included a combination of process staffing roles, implementation of a mobile workstation to streamline the process and eliminate Non-Value Added Activities (NVAA), and associated benefits of a reduced total process time. A time study was conducted to enable analysis of data on total time and throughput for the existing and new processes and help identify process improvements.

The new process enabled both an increase in the number of items or loads that could be processed per shift and an increase in the visibility of inventory within online systems. The reduced cycle time eliminated the need for mandatory overtime by preventing backlog within the receiving process. The number of resources required for the overall receiving process was also reduced. All of these benefits enable the warehouse to better support the manufacturing plant while reducing overall process costs.

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Introduction

Currently, Case New Holland Industrial (CNH Industrial) utilizes an offsite warehouse to receive and prepare materials and parts to be transported to a nearby manufacturing plant. The space to store large quantities of inventory is limited and undesirable in the plant. Therefore, the efforts of the offsite warehouse are used to support a Just in Time (JIT) approach at the manufacturing plant. Just in Time is a lean inventory management approach which reduces inventory by receiving it just as or just before it is needed. An analysis of the offsite warehouse's receiving process has been conducted in order to measure the inefficiencies associated with the current receiving process through the collection of data. This project has been completed to allow for the design of a system which fosters timely receipts of product into the Warehouse Management System (WMS) and the plant's Materials Requirements Planning (MRP) system called (CMS) Case Manufacturing System. Ultimately, the main goal of this project will be to improve the timeliness and accuracy of the receiving process while reducing None-Value Added Activities (NVAA).

CNH Industrial uses a methodology called World Class Manufacturing (WCM). This particular CNH Industrial location requires all new employees to not only understand this methodology but also correctly apply it to daily tasks. Understanding the driving force behind why WCM is implemented at CNH Industrial was easy because the company seeks to perform just that every day: World Class Manufacturing. In CNH Industrial's production system there are many processes that are "World Class" and are core competencies of their business. An example of this includes the process of bringing activities in-house to allow for greater control over specialty areas or areas that will be improved to someday become world class. The training and tools in the logistics section of the WCM structure have supported this project and how it was conducted.

Current State

Process Description

A brief description of the receiving process before the application of this project, shown in Appendix A, is explained below. The receiving process begins when a delivery arrives. Product is then transported from a semi-trailer/sea-container to where it is stored in a temporary holding lane. Next, an employee in the Checker position performs an audit of the packing slips found on the box versus the actual quantity received. Then, this employee creates and applies a label used for tracking inventory internally. Once labels are applied to boxes, the barcodes on these labels are scanned, which will place the information found on the labels in the WMS. In order for this inventory to be received, the packing slips are then sent to a Receiving Clerk who reviews the work of the Checker and receives the products into the WMS. The receiving step, within WMS, makes the inventory available and allows for the plant to pull from it as needed or scheduled. While receiving inventory in WMS, it is also the responsibility of the Clerk to address issues with discrepancies found in the audit such as overages, shortages, missing packing slips, and more. Finally, the inventory is moved from the holding lanes (shelved) to be put away within the warehouse. In order to fully understand the current receiving process it is recommended Appendix A be reviewed.

Problem Statement

The offsite warehouse's receiving process poses a problem for the JIT strategy utilized by the manufacturing plant. If products are not processed in a timely fashion, and they are not available for the plants disposal, then there is a possibility of a line down situation. Another problem which must be avoided is having all holding lanes full of products while additional deliveries are scheduled and forced to be delayed. In order for these undesirable situations to be avoided, the current process requires improvements to effectively support the volume of throughput required to sustain the needs at the manufacturing plant.

The problems of the receiving process stem from several key categories including equipment, NVAA, computer system requirements, and the current system itself. Within each of these categories, there are multiple problems or areas that contribute to the inefficiency of the receiving process. The categories mentioned are explored below.

The equipment used to support the receiving process is a deterrent to its efficiency. Some of the limitations come from a lack of equipment, damaged equipment, and equipment that is shared. The lack of scanners causes Checkers to have to wait for an available scanner, search for it once it is available, and look for a scanner that fully functions, as some have triggers that do not work. Further contributing to the problem experienced with scanners are that some have batteries that do not hold a full charge. Another piece of equipment that adds time to the total process is the label printer. There is currently one label printer that all of the employees in the Checker role print from. When multiple employees send information to the same printer, labels are not batched and become intermixed with labels created by others. This requires labels to be sorted, which adds time to the total process and introduces an opportunity for potential errors.

There are multiple NVAA that have been identified in the receiving process. Many of these activities are from empty trips to retrieve and return tools needed to complete the auditing process. Some of the items that employees leave the holding lane for are box cutters, saran wrap, forms, labels, and more. Other non-value added activities come from multiple audits which are performed by the Checker and Clerk. The disconnect between these two employees not seeing the same information adds steps to the process, opportunities for errors, and a need for a strong communication flow. It has been observed that a strong communication flow between these two employees is difficult because they are located in different parts of the warehouse. Another obstacle which interferes with communication is that the Clerks are isolated from the process by being located in a cubical which creates a physical barrier.

The computer systems used in the receiving process are complex and require manual data entry to receive products. Although the computer systems are what manage inventory, supporting them requires additional time in the total process. In order for parts to be visible in the WMS and CMS, an item has to be entered by the Checker and received by the Clerk. The auditing and receiving process is lengthy. When packing slips are received by the Clerk, the amount of time for items to show in the computer systems versus when they have been placed on the dock limits visibility of this inventory.

As mentioned, there are limitations that impact the current receiving process itself. First, there is little allowance for lag time in the receiving process. This is due to the plants requirement for products to be transferred from the warehouse to the manufacturing line as needed. Second, the amount of physical dock space/ holding lanes is fixed. The fixed amount of space in the warehouse requires the need for a system which allows for inventory to be cycled efficiently from holding lanes. Efficient cycle times are critical for later scheduled shipments to be received and a costly line down situation avoided.

Another receiving problem is when the receiving process at the warehouse falls behind schedule. Employees have been working ten hour days and some shifts on weekends to keep up with the incoming flow of deliveries. With the current inefficient process, all holding lanes have become full before items are audited and received into the computer systems. This has caused material to be temporarily placed in areas that are not holding lanes which is a safety concern and causes extra material handling.

Currently, the need for a solution which supports the throughput of material needed to keep the manufacturing plant inventory at desired levels is a must. In order to design this system, the space and timing constraints must be considered.

Purpose of Project

The significance of the Receiving Process Improvement Project lies in designing a "World Class" receiving process that supports the functions of the manufacturing plant. Logically, developing a solution that satisfies the needs addressed in the problem statement will have the largest impact on the current process.

In order to make this paradigm shift, a process must be implemented that allows for products to be received, audited, processed, and shelved efficiently. Along with the problems that stem from timing requirements from the plant, the current procedure is a problem within itself. Many items are handled multiple times and there are unneeded steps involved. Paperwork handoffs, isolation of resources, and label printing procedures all present opportunities for issues and errors. Rework to fix these errors, along with overtime needed to maintain levels of inventory for the plant, add unplanned time and resources needed to operate at acceptable levels.

Each of these issues add cost and time into the process. Although, this process presents itself as a problem, there is an opportunity for improvement and "World Class" logistics to be applied.

Literature Review

Numerous supply chain, operational, and process improvement methodologies have been applied in the implementation of the Receiving Process Improvement Project. Several of these key concepts are discussed and reviewed in the section below.

5S

One useful methodology to structure and improve a process is 5S. The 5S methodology comes from a translation of five Japanese words: serie, seiton, seiso, seiketsu and shitsuk. When loosely translated, these five S-words are: sort, systematize, shine, standardize, and self-discipline. Translations for 5S can be seen below in Figure 1. Each housekeeping phase plays an important role in the overall change seen from implementing 5S. This is because each phase addresses a different area to improve upon and provides different recognizable benefits. Newton, Schmidt, and Robertson (2003) state, "The objective of implementing a process improvement such as Five-S is to have a cleaner and efficient workspace with a standardization of work procedures" (p. 32).

Japanese Term	English Translation	Equivalent Term Starting With the Letter "S"
seiri	organization	sort
seiton	Tidiness	systematize or simplify
seiso	Purity	sweep or shine
seiketsu	cleanliness	standardize or sanitize
shitsuke	Discipline	self-discipline or sustain

Figure 1. 5S translations. Adapted from "Implementing 5S to promote safety & housekeeping," by J. E. Becker, 2001, *Professional Safety*, 46(8), p. 29.

Their study suggests how 5S can be adopted from its standard manufacturing application and applied to warehouse and distribution centers. Taking this a step further, 5S can be applied to other areas where improvement through organization is desired. Others have applied the same strategy or parts of 5S and received the same levels of results achieved in a manufacturing application. Newton et al. (2003) continued by stating "The Five-S system is a powerful tool that focuses on three essential concepts: effective work place organization, simplification of work environment, and reduction of waste". They stress the need of having a project plan to use when implementing 5S. Through using a 16 point implementation plan that provides a roadmap for 5S in a warehouse application, and focusing on the concepts above, "…led to an organization driving improved quality levels, while increasing efficiency and effectiveness" (p. 34).

An application of 5S which might not first come to mind is for safety. This is sometimes considered an additional S word that is added to the standard five which then forms 6S methodology. However, it has been suggested that this phase is implied within the application of the first five phases. 5S can be utilized as a way to make workplaces safer. Becker (2001) states, "Good housekeeping will eliminate safety problems, improve morale, and increase efficiency and effectiveness. Employees appreciate a clean orderly workplace where they can accomplish tasks without interference or interruption" (p. 29). Safety benefits can come from multiple areas of the 5S methodology. This allows for numerous safety problems to be avoided or removed and additional benefits to be realized. Many of these benefits come from applying organization and structure while removing items from the process that are not necessary, which supports a lean point of view. Removing clutter from a workstation not only makes it safer but also allows for gains in efficiencies.

With the importance of safety in the workplace, it can be argued why this model could or possibly should be modified to adopt another S-word, with safety playing a supporting role. Through changing the 5S model with the addition of a safety aspect, the model would be able to be applied to more scenarios while continuing to support manufacturing, warehousing, and more.

Once any system change has been implemented it is important to sustain the changes made if they are desired. Sustaining change can be difficult as employees can quickly revert back to a previous process or deviate from a new process. However, Casey (2013) states a benefit of 5S is, "When a strong 5S program is in place, it is extremely easy for leaders to walk around and see whether people are operating to the plan and using the best practices. When everything is in its place, a leader knows everyone has exactly what he or she needs and has a baseline to start additional continuous improvement projects" (p. 20). In addition to the ease of a visual check to see if a 5S program is being sustained, an operator checklist can be used. This checklist serves as a simple tool which walks employees though steps that need to be sustained for the program to operate effectively. There are several steps that correlate to each of the 5S areas and a check can be performed at any time during operations. This allows for the check sheet to present key process steps which need to be maintained. A check sheet is easily posted near a workstation, handed to employees, or used as a reference to reinsure 5S steps are sustained. An additional benefit is the same check sheet can be utilized by multiple shifts.

Although, the tool mentioned above highlights how to sustain 5S, there are other ways to implement 5S which might achieve greater success with North American companies. This has been discussed by Casey (2013) who recommends secrets to sustaining 5S success, "The secret is to start at step four by defining your standard and move to step five (systematize) by having a process to systematically measure the orderliness" (p. 21). This proposed change can be viewed in Figure 2. The suggested model start point is the Standardize phase. This proposed change may better a user by providing a structure behind the metrics that are being strived for. This will allow for planning to take place before items are sorted. There will also be a standard way to measure the actions put into place.

Restructuring the 5S cycle seems to offer several advantages. There is an option to plan for desired outcomes in each of the steps before they are implemented. Through planning the system metrics first there will be more control over the whole process. However, if implemented with the original cycle, the first step being shine, the cycle is started with an action item. Starting with an action item can be advantageous, as it is a way to implement changes quickly and remove clutter from the first step in the system. Both options mentioned allow for flexibility within the cycle. It is important to remember 5S is a cycle and all steps should plan to be covered within the cycle before restarting the project again at any desired phase.

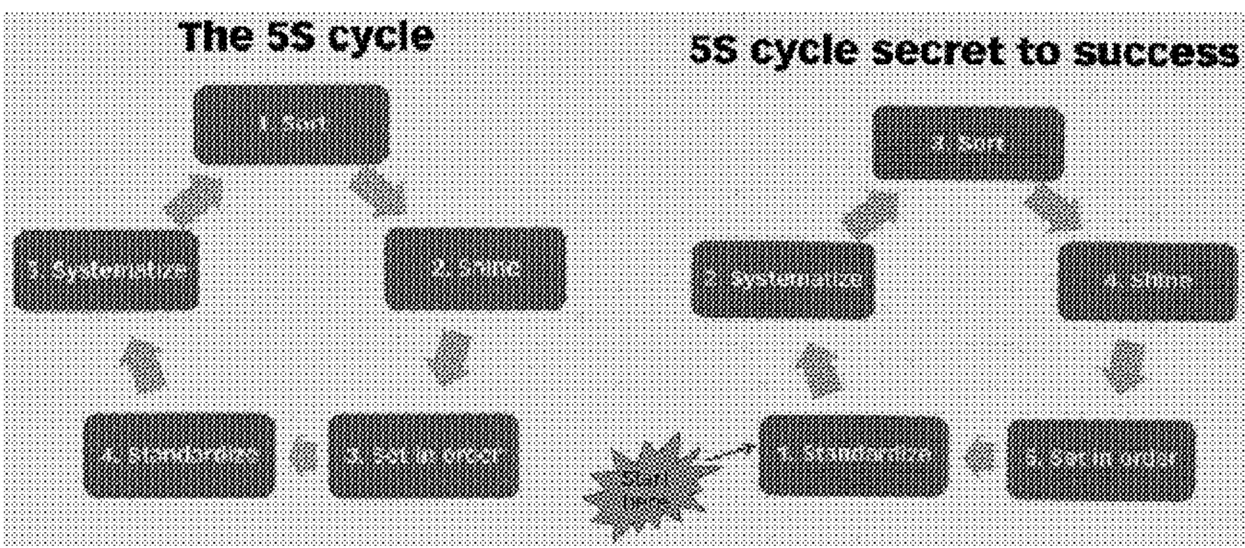


Figure 2. Comparison of the 5S cycle and the 5S cycle secret to success. Adapted from "5S SHAKEUP Three secrets for sustaining 5S success," by J. Casey, *Quality Progress*, 46(10), p. 20-21.

Continuous Improvement- The Deming Cycle/PDCA

The Deming Cycle is a continuous improvement tool which is supported by four phases: Plan, Do, Check, Act, which was actually changed to Plan, Do, Study, and Act. However, these steps are ultimately the same and companies today use both sets of steps.

The thought of utilizing the Deming Cycle as a process improvement tool has been applied before at CNH Industrial. However, there are multiple ways this tool is modified for specific applications. It provides a roadmap to structure an entire continuous improvement approach. The flexibility of this tool can be seen below.

An area often overlooked to apply lean concepts to is Information Technology (IT) departments. However, Ryan King, the director of information technology at a packaging machinery manufacturer, has used PDCA to successfully improve processes and eliminate waste in the department he manages. Minter (2012) states, "PDCA instills a 'trial and discovery' mentality that determines success with a process or project by whether the evidence bears out its success or calls for further changes" (p. 40). This statement highlights one of the strengths of the PDCA cycle; change is based on supportive data within the Check Phase which allows changes to be analyzed.

PDCA provides phases for activities to be structured within. For continuous improvement seekers, the activities used to support a specific phase will vary from company to company and application to application. An example of how the application of PDCA varies can be seen as it was applied to a manufacturing process reengineering project. In this example, they used computer simulation to model proposed changes. The simulation allows for a system to be tested before a large sum of capital is spent on implementing new machinery. This approach allows for an optimum layout to be designed and studied. Through simulation, modifications to the process can be made. Lyu (1996) states "With the addition of interactive control ability, users can halt the simulation experiment at any moment to view the statistics and/or change some parameters; insights into the system's behavior are then understood" (p. 129). The ability to analyze data as adjustments are made is a significant benefit, while in other studies, a physical change must be put to a trial in order for data to be first collected and later analyzed.

Another application of the PDCA cycle is as a product management tool. Figure 3 (below) compares the application of PDCA/PDSA as a continuous improvement tool versus PDCA as a product management tool. When used as a product management tool, the steps in the system stay the same, however, the check step is used as an internal quality check. This quality check is the deciding factor if a product will be sent to the next process or if it will be held internally for further actions ranging from scrap to rework. Gupta (2006) explains the history of PDCA and how it was developed from a statistical control model and that, "The check has been tied to the product specifications instead of the statistical control limits. As a result, intent of process control has been lost and PDCA began to be used for product management" (p. 46).

As a product management tool this model would function, however, it adds additional cost by having repeated continuous quality checks. Within these quality checks, products are only judged by their individual control limits. Gupta cautions a valid concern as the undesired manufactured products are fixed later, where originally a change would be made to bring production back into statistical control, which would remove the need to manage manufactured products that were not to product specification.

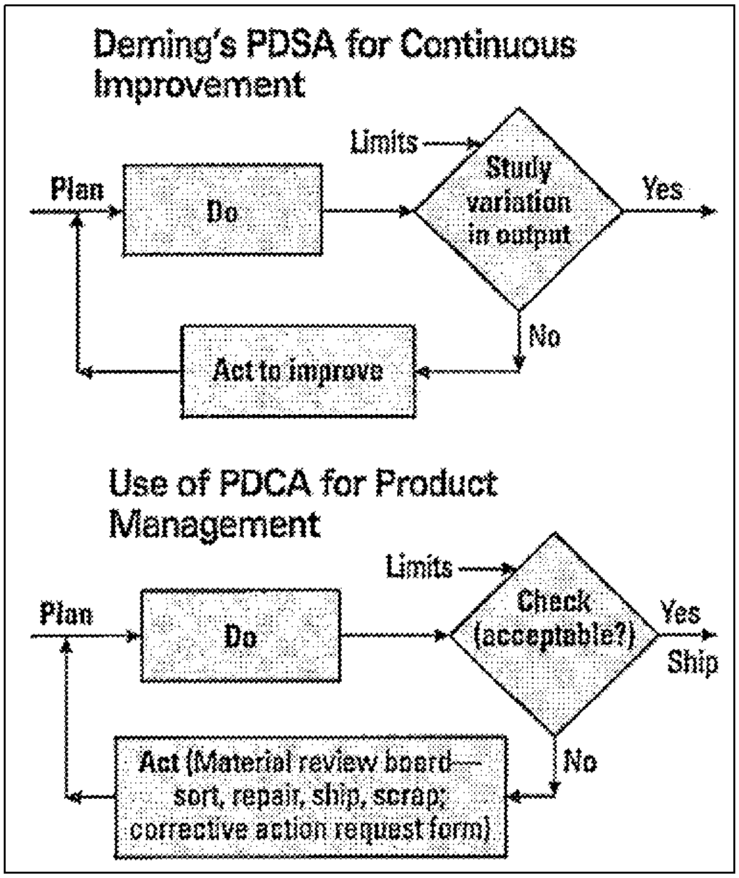


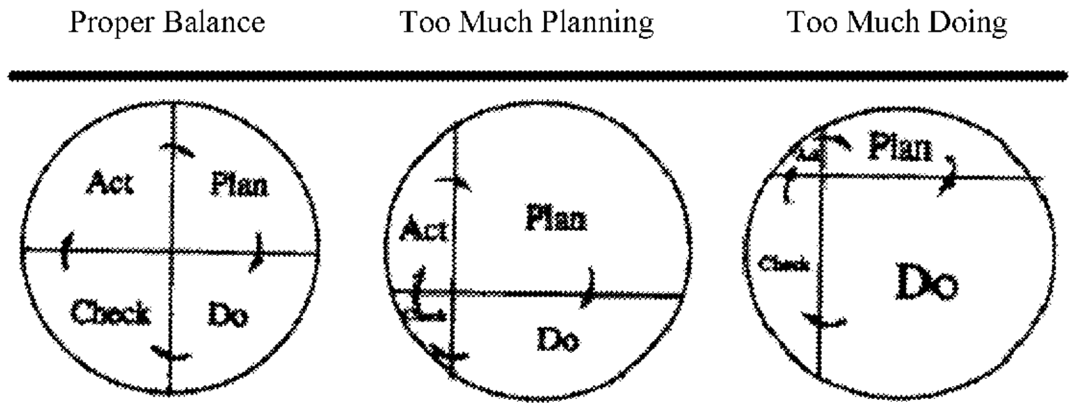
Figure 3. PDSA cycle for continuous improvement versus PDCA for product management. Adapted from "Beyond PDCA—A New Process Management Model" by P. Gupta, 2006, *Quality Progress*, 39 (7), p. 46.

Different ways the PDCA method has been used and modified to implement process change have been analyzed. Although these modes are different, they are still striving for the same goal of an ideal process. This highlights one of the key features of the PDCA method as a flexible guideline for process improvement and supports users in their specific applications.

After reviewing how the Deming Cycle is used in practice, challenges can sometimes arise because the method is used incorrectly. This is because there are many process improvement projects that overlook one or more of the steps in the Deming Cycle before coming back to the first step and restarting the cycle again. A few examples of this are when projects lose steam and never make it to the last cycle, there is not a study step and a plan is implemented, when the study step is skipped and the project goes off on a tangent, and when the model is not restarted.

The problem that arises when the cycle is not restarted is that the model switches from a continuous process improvement model to a one-time process improvement approach. This is because the same project metrics must be revisited after the completion of the first cycle to determine if the changes in the Act Phase worked as planned. If another process improvement project is started without review, the cycle is broken. This leads to implementing process improvements with no way to measure if the changes made were successful.

A similar problem that can occur when using the PDCA cycle is when an uneven amount of planning or emphasis takes place in each stage. Below, Figure 4 shows the proper balance that should take place in the Deming Cycle. Benneyan and Chute (1993) suggest, "A team should plan only as much as they can do, do only as much as they can then check, check only as much as can then be acted upon, act only as much as can be planned, and so on as the PDCA cycle continues. Attention is given to each of the four activities so that they support each other, without one dominating the others" (p. 36). Balancing a project evenly can help to ensure success in each step as the cycle is completed.



Proper and improper balance of all quadrants in the PDCA cycle

Figure 4. Balancing the PDCA Cycle. Adapted from "SPC, process improvement, and the deming PDCA circle in freight administration." J. C. Benneyan and A. D. Chute, 1993, *Production and Inventory Management Journal*, 34(1) p. 36.

As mentioned, a continuous improvement process commonly used by CNH Industrial is the Deming Cycle. Therefore, this methodology has been applied to the design of the Receiving Process Improvement Project. In the sections below, there is a breakdown of the cycle with a description of how it was used to support continuous improvement. There is a corresponding description of how each step was utilized to support the Receiving Process Improvement Project. These sections will also list several of the key activities that were performed.

Identifying Opportunities for Improvement

Plan Phase

The Plan Phase is important to the process and should not be overlooked or cut short. This phase serves as a means to support the entire project moving forward and is the foundation that a project is built upon. Planning which activities will take place and when will help to develop steps to identify where the true root causes of problems lie. A well-developed plan will link together steps to complete the project and will help avoid skipping necessary actions.

The Deming Cycle provided a holistic approach to the structure and design of the Receiving Process Improvement Project, with initiating the Plan Phase being the first action item. The development of a project charter served as the first document in kicking off the project. With the creation of this document, the project scope, a timeline with milestones, project stakeholders, problem statement, contacts, resources, and more was established. This helped plan how the project was structured and what activities took place.

The deliverables for each of the phases in the Deming Cycle were created in the Plan Phase. These deliverables were maintained in a PDCA action list, which allowed for the status of each activity to be updated and tracked throughout the improvement process. Within the action list, there is a category that allows the progress for each action to be measured and updated. There is also a visual check to mark and easily see if an action has been completed. This allowed for the open action items to be identified and worked on. Another tool setup in the Plan Phase was a shared drive where documents were posted and updated online. The usefulness of this online storage tool came from allowing multiple employees the option to view, change, or create documents which supported the project.

The last step in the planning phase was to set dates for several recurring project status meetings. These meetings served as a way to keep the project progressing in the desired direction; forward. There was also a great deal of interaction and feedback provided in each meeting. This feedback helped improve the project by having additional employees not directly performing analysis involved. These additional employees were able to provide valuable input. Through keeping project stakeholders informed in these meetings, the communication flow provided a channel to ask questions, seek input, and sparked additional ideas.

Do Phase

In the Do Phase of the Deming Cycle the goal is to act upon the strategy outlaid in the Plan Phase. Each step that was previously planned for this stage is to be initiated or put into practice. The Do Phase allows for exploration and changes to begin. Some of the possible supporting activities of this phase are identify root causes, collect and analyze data, implement changes, and more. Actions that support how the new process was designed were completed in this phase as the improvements were implemented.

The first step in identifying where room for improvement lies is to understand the system that is currently practiced. In order to understand the current receiving system, many hours were spent observing, questioning, and participating at the offsite warehouse. These hours helped provide a greater understanding of the logistical flow of the warehouse and allowed a clear perspective of daily operations to be developed.

The time spent at the warehouse was used to act as an unbiased party and evaluate the receiving process. Understanding the standard practices of the receiving group supported the construction of a process flowchart. As the flowchart was created, many lines that linked one process to the next were penciled in. Once the map was completed it looked similar to a maze of lines.

Once a rough sketch of the flowchart was made, an analysis was performed to identify and highlight the NVAA. Examples of items highlighted on the flowchart were when products were moved, touched, or an employee had to leave their work area. The reason why an employee left the work area was recorded. Most times this was a result of not having a required item needed to complete the audit process nearby. The creation of the NVAA flowchart served as an easy way to gain a visual of where and how many of these activities took place in the process. The information recorded in the initial flowchart was used to construct an electronic version of the receiving process (Appendix A).

Once the observed process was documented, a copy of the previously documented process, which is provided to new employees as Standardized Operating Procedure (SOP), was obtained. It was important that the process was observed and documented before viewing the document of the current process. This allowed analysis of the process currently in practice without the influence of a document stating how the process was designed to function.

The documentation that was presented to new employees as SOP was interesting to review. This is because a comparison was made between the previously documented process and what activities where taking place on the warehouse floor. This served as a useful tool to identify variation in the process. This also highlighted areas which can be improved upon and opportunities were identified. Most of the variation in the process was small. Some employees deviate from the steps listed, some added steps, and some skipped or missed steps.

After the data mentioned above was collected on process flow, NVAA, and SOP, the product throughput needed to be recorded. Data was collected from time studies and was mined to display Key Performance Indicators (KPI's) from a sample of shipments. Key Performance Indicators are the specific metrics a company or industry uses to measure successful operations. The collection of this information was required to serve as a baseline for comparison. This was used later in the Check Phase to show the amount of improvement that was made in the time required to complete each step in the receiving process.

Another tool that was used in tracking the observed process was a spaghetti diagram. This tool is used to outline the path of a process. Whether the item being tracked is a part, person, or another object, a line is drawn where this item moves. The spaghetti diagram of the Checker can be seen in Appendix B. The diagram highlights the amount of distance covered in the existing process.

After the creation of the process flowchart, some general notes were recorded on processes that seemed odd or repeated. Having documented how the system works on a day-to-day basis, notes were reviewed on the current process, the NVAA, and spaghetti diagram. When these documents were viewed from a supply chain and process improvement mindset, several opportunities for improvement stood out, and will be mentioned later in this paper.

New System Design Process. The next step in the phase was to design a new system/solution which would address the NVAA identified in in the flowchart and problem areas found. Taking into consideration the recognized opportunities for improvements, a brainstorming session was held. After multiple ideas were generated, there was a need to narrow the number of ideas and move closer to selecting a new design. Ideas were scored on multiple criteria based on if they supported the items identified in the problem statement: the need to support throughput volume, accuracy, and reduce material handling. At the same time, safety was a large concern. The solution with the highest potential to improve the current process was selected for implementation.

After reviewing the needs of the current system, the plan to use a mobile work station was chosen. This design would provide a number of benefits and improvements needed in the receiving process. The mobile work station allows for all items crucial to the receiving and auditing process to be brought to the holding lane, thus removing excess trips required to retrieve and return these items. This strategy also supported the desire to increase visibility of inventory in the software used by the warehouse and plant. By equipping the mobile work station with a computer, scanner, and label printer, items were now able to be added to the system as the Checker moved down the lane. Essentially, this changed the receiving process from a batch to a single piece flow, which allowed items to become visible in the systems sooner. By reducing the number of items that wait in a queue until the next sequential step is performed, the process recognizes each product as it is entered. The new process flowchart, which highlights the required activities, can be seen in Appendix C.

Another change required for the new system was to implement cross-training of existing employees. The entire process to receive products into the system can be performed by both the previous Clerks and Checkers in the newly formed role. This allowed for more employees to audit products at the same time. The second reason this was performed was to remove periods of time when the Clerks were waiting for Checkers to deliver packing slips. Also, by bringing the Clerk's responsibilities to the new combined role, the discrepancies that were found in the paperwork generated by the previous separation were removed.

New Process Trial and Implementation

The Do Phase can act as a trial stage for the desired process improvements. The trial works by initiating a test or portion of the project before making full scale changes. This allows for a plan to optimize improvements to be created in the Check Phase which will be worked into the full scale implementation in the Act Phase. A trial period of the new system design was conducted with a cross-trained employee aided by a mobile cart. The information on this trial is found below in the Data Analysis section.

Check Phase

The Check Phase of the Deming Cycle is used to analyze the changes that were made in the Do Phase. This provides data on how effective the changes were and provides an opportunity for comparison between the new and previous state. Through performing the Check Phase there is a step to identify what additional actions should take place after implementation to meet the objectives set in the Plan Phase.

Data Analysis. Over a month period, data on throughput of the receiving and auditing process was collected for analysis. The average time required to process a receipt was calculated. Next, a time study test was conducted that tested the newly designed system with a cross-trained employee. This was done by utilizing a mobile workstation next to a temporary product holding lane. Data and information on the throughput of the newly proposed process was recorded and analyzed. It was confirmed that through the combination of the Checker and Clerk roles, along with the support of a mobile workstation, there was an improvement in cycle time. The total time to receive an average load of product was reduced by about 35 minutes per load. A summary of process throughput improvement can be found below in Table 1. This table further evaluates the data to show the average time required to process a skid of product.

Table 1.

Average Time to Process Received Load

	Previous Observed Rate			Proposed System Test Rate			
Average Time	Checker	Clerk	Combined	Checker	Clerk	Combined	Combined Difference
Per Load	1:10:00	0:30:00	1:40:00	0:35:37	0:30:00	1:05:37	0:34:23
Per Skid	0:04:52	0:01:12	0:06:04	0:01:26	0:01:12	0:02:38	0:03:26

Note. The average time per load for the Clerk remained the same in both the observed and test design. This is because the time and process to receive products in WMS was not affected.

The new system's cycle time resulted in a great gain in efficiency as well as additional benefits beyond the time reduction. Some of the additional gains lie in the reduction of processing errors from the hand-off of information between employees, items are introduced into the WMS system faster, and employees have not been required to work overtime.

The average improvement in cycle time reduction observed in the new process will affect the total throughput exponentially. There are multiple shipments received each day on both first and second shifts; Table 2 displays the average number of scheduled trailers daily.

Table 2.

Average Number of Scheduled Loads per Day

	Shift		
	First	Second	Total
Average Daily Loads Scheduled	21	15	36

The average cycle time reduction will benefit CNH Industrial every time a load of products are received, which will account for a greater recognized improvement. With the proposed changes, another significant benefit will stem from not requiring employees to work shifts longer than eight hours to keep up with the volume of incoming deliveries. This will result in significant savings from a cost containment approach. There will also be multiple benefits from avoiding attrition.

Act Phase

The Act Phase allows for the changes and opportunities identified as desirable in the Check Phase to be fully implemented. In this stage, improvements are recognized as changes are applied and standardization is the solution to implementation as full scale changes are rolled out. If the data analysis did not prove to support the implementation of any proposed changes, they do not need to be implemented. However, this step is still important as the information can be viewed as a learning tool. This information should also be used when the continuous improvement cycle is started again at the Plan Phase.

With the identification of increased throughput and additional added benefits observed in the trial period, the decision was made to move forward with the proposed receiving process. This required an implementation similar to the pilot test, but the full scale changes affected all employees on the receiving dock. Managing the changes made was an important task in making the switch to the new receiving process. Based on discussions with management, it was decided to implement the changes on first shift for three days to allow the new process to stabilize before standardizing the changes on second shift.

The actual implementation of the new process was organized and broken into several key activities; receiving, preparing, and training employees. A list of all items required for the process and the specific items needed on the mobile workstation was created. Next, quoted items which had the longest lead times were ordered first. While waiting for items to be received, several action items in the preparing step could be started to keep the project progressing. During this time, accounts were created for all employees to log-on to the computers, WMS, and scanners.

Once all needed equipment was received, it was assembled and prepped for use. This included using 5S to organize each mobile workstation, the mobile workstation charging area, and the filing system where the Clerks were originally stationed. The 5S methodology provided structure for the new process. Part of this step also included restructuring the holding lanes to accommodate a cart; an example of the new process layout and structure changes can be viewed in Appendix D.

Next, all of the Checkers and Clerks were trained on the new equipment and processes of which they were not yet familiar. The training provided new SOP with a detailed and high level list of action steps. Then employees were allowed to practice using the new mobile workstation system. For the Checkers this meant learning by doing with the guidance of another already capable Clerk and a member of the implementation team. The Clerks were provided training on the Checker's duties and allowed to experience the mobile carts as well.

After employee training, the remainder of the implementation was relatively simple. Guidance and support was made available to all the Checker/Clerk employees over the first weeks in order to resolve any problems or questions that arose.

Significance of the Project and Next Steps

The previous sections have addressed why and how this project took place. Now, we will analyze the significance of this project. Most importantly, the new process better supports the needs and requirements of the manufacturing plant. Beyond satisfying the main goal of this project, additional benefits were achieved through improved quality and cost reductions.

The changes implemented in this project may be utilized as a model for other warehouse locations. Establishing an efficient system which streamlines the receiving process could potentially set the stage for multiple locations across the company. This would allow for CNH Industrial to benefit from the system each time it is implemented at a new location.

Moving forward, there has been a recommendation to modify how labels are generated and system changes in WMS to make receiving more user friendly. Currently, each label has to be created by keying in information on the handheld barcode scanner, but a request has been made for WMS to allow all labels to be created from an advanced shipping notice. This would save a tremendous amount of time for the receiving process. An audit could take place comparing the auto generated labels to physical box quantities and a limited number of labels would need to be created manually.

Although this option is currently being explored, there has been a noticeable reduction in the total time to receive a load of material from the changes recommended and already implemented within the Receiving Process Improvement Project.

Summary and Conclusion

Through analyzing the design and implementation of this study, the effects of process improvement can be seen. An approach to identify, design, check, and implement process improvement has been presented. An explanation of each step of the Deming Cycle, using the steps Plan, Do, Check, and Act, has been provided. Sample activities and how to apply this methodology have been examined and discussed.

The Deming Cycle, as a continuous improvement tool, played a large role throughout the project. Each of the four phases: Plan, Do, Check, and Act served a key role in the structure and organization. There are multiple ways this tool can be utilized and the flexibility has been seen through the application within this project.

More specifically to this project, a design which streamlined and improved a warehouse's receiving process was implemented. This was supported by removing NVAA, applying 5S, utilizing a mobile powered workstation, and cross-training employees of the receiving process. Removing NVAA helped streamline and increase the efficiency of the receiving process. Activities that did not support the process where identified, reduced, and removed. Through utilizing 5S, a structure was put in place that outlined where tools and paperwork are stored. 5S also helped to sustain the process through organization. Implementing mobile workstations allowed for all of the tools necessary to receive products to be brought to where the actual work was being performed. The mobile cart assisted in reducing NVAA, for example, walking to get labels from a shared printer before they could be applied. Cross-training employees helped to remove multiple audits of the same work. Through training employees to perform all receiving functions, the bottlenecks that were observed when the process switched hands were removed.

Through decreasing the cycle time of the receiving process, multiple benefits have been recognized. Not only was there an increase in the number of items or loads that could be processed per shift, there was also an increase in the visibility of inventory in WMS and CMS. Additional benefits came from not needing mandatory overtime, greatly reducing excess labor costs. Once the new receiving process was fully implemented and stable, these benefits were fully realized.

After reviewing the changes implemented within this project, it is important to remember continuous improvement is just that, continuous. The receiving process had been restructured and improved upon before, and it will happen again in the future, as can be seen in the recommendations to implement WMS software enhancements to support the label printing process. Understanding that change is constant, change can be tracked and measured, and change can be constantly strived for, is a key takeaway from the orchestra of this project.

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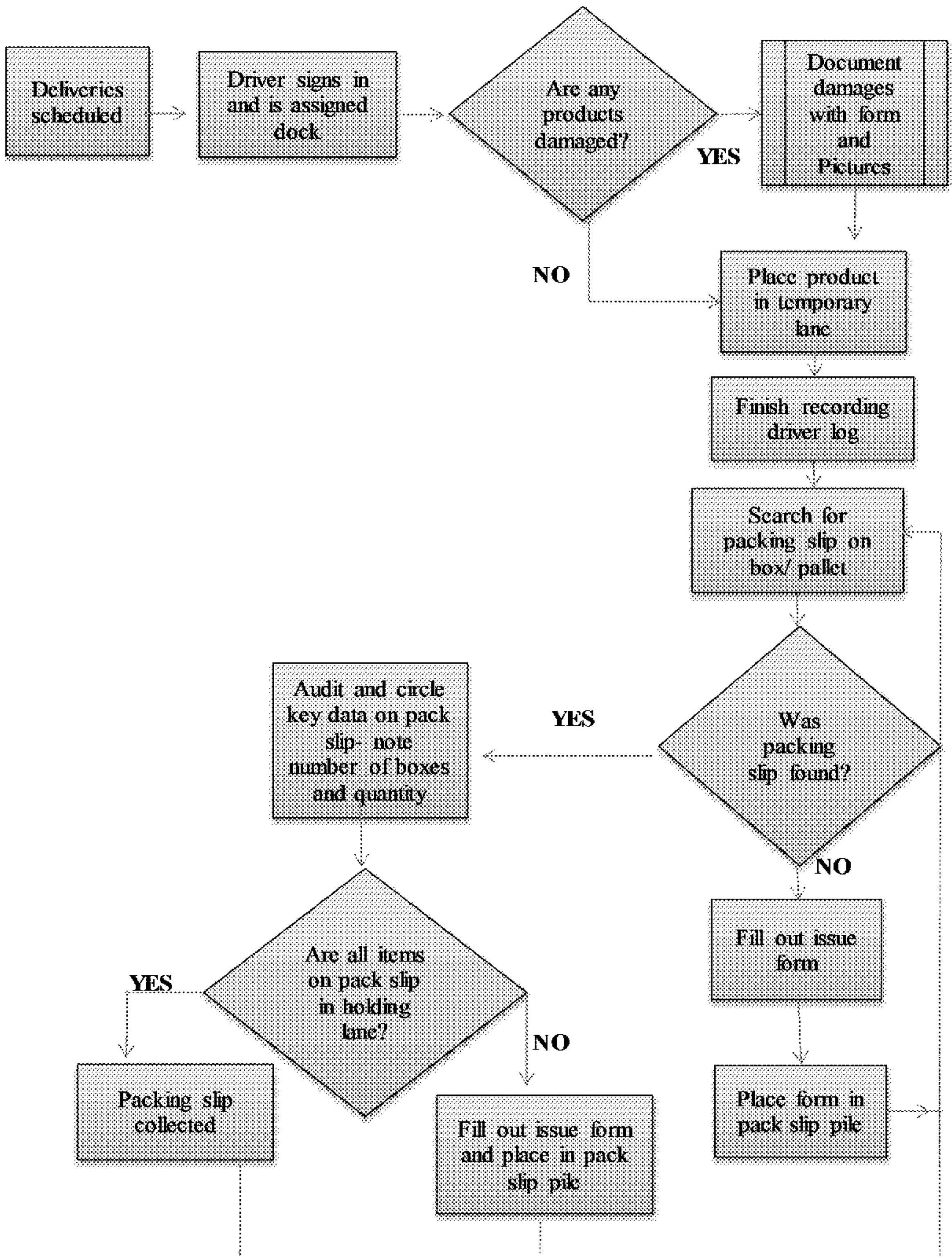
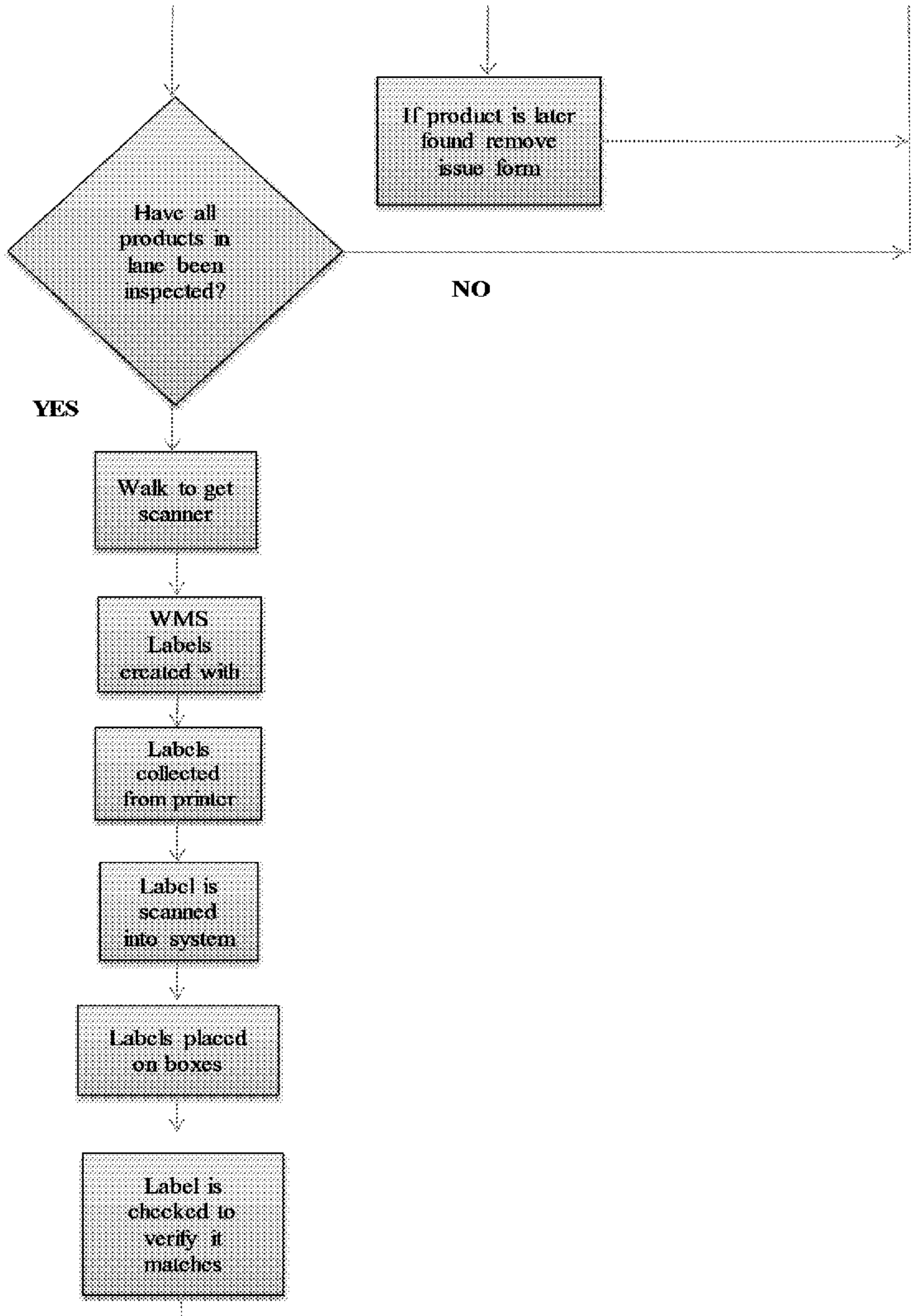
Appendix A

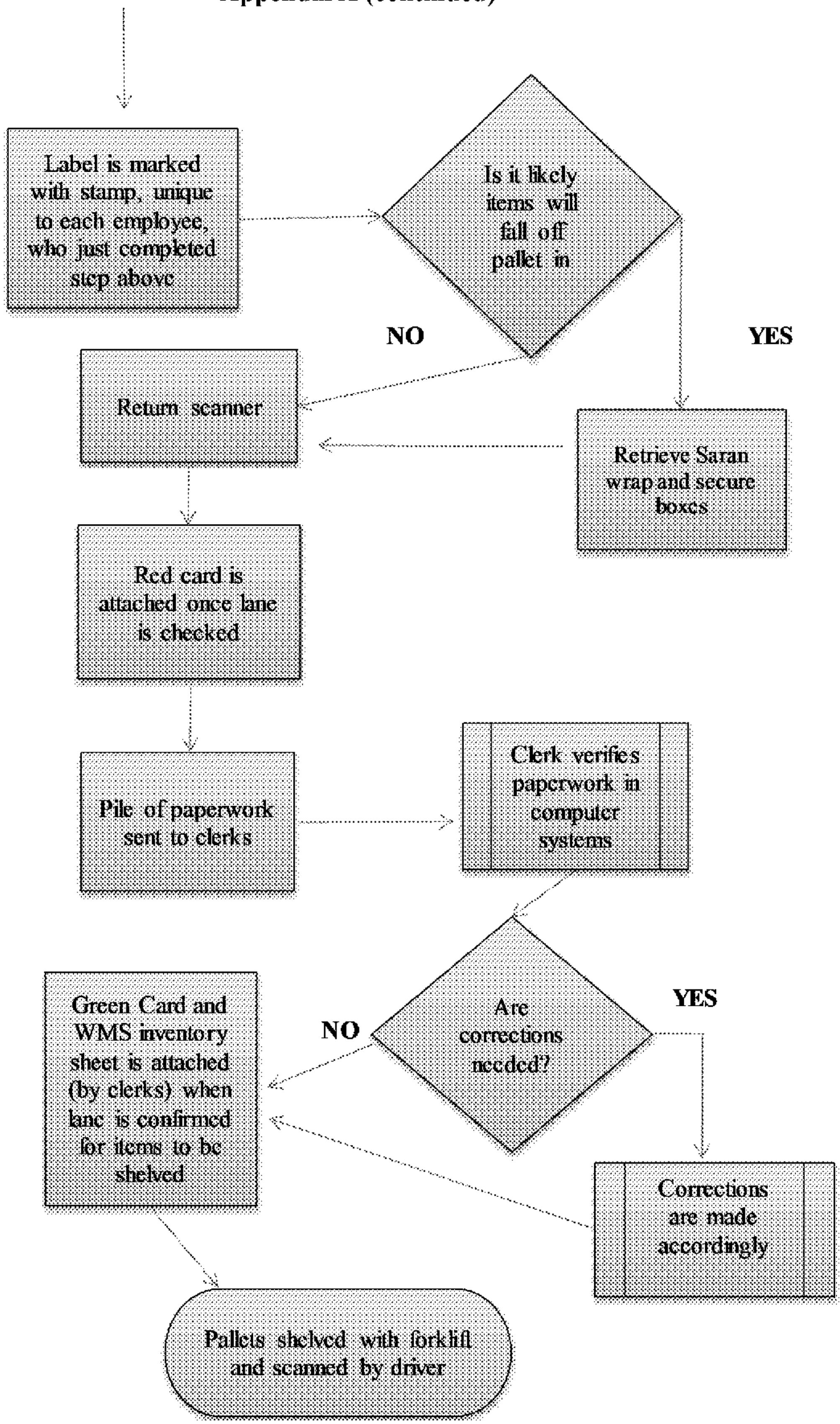
Observed Receiving Process Flowchart



Appendix A (continued)

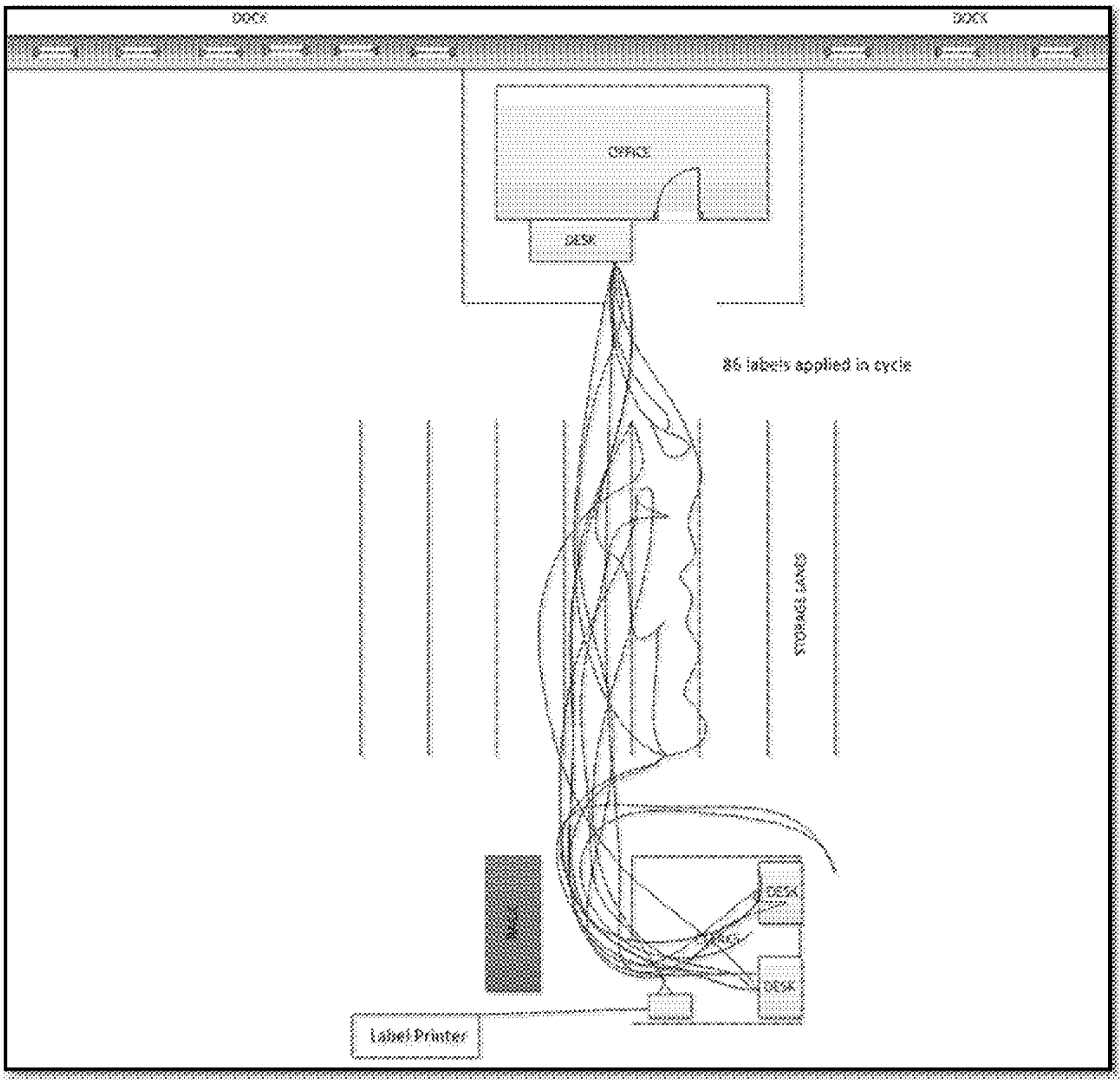


Appendix A (continued)



Appendix B

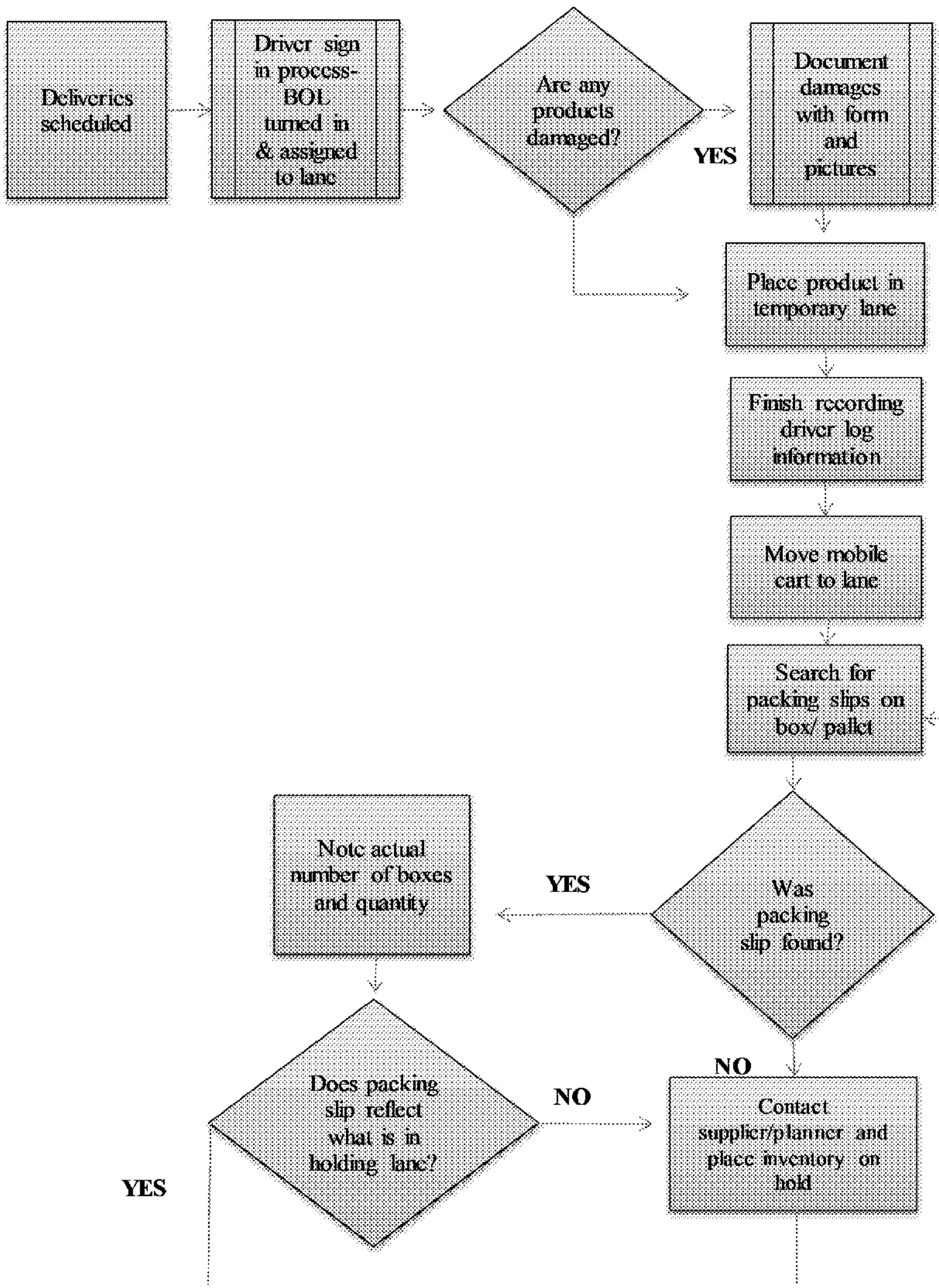
Checker Receiving Process Spaghetti Diagram Example



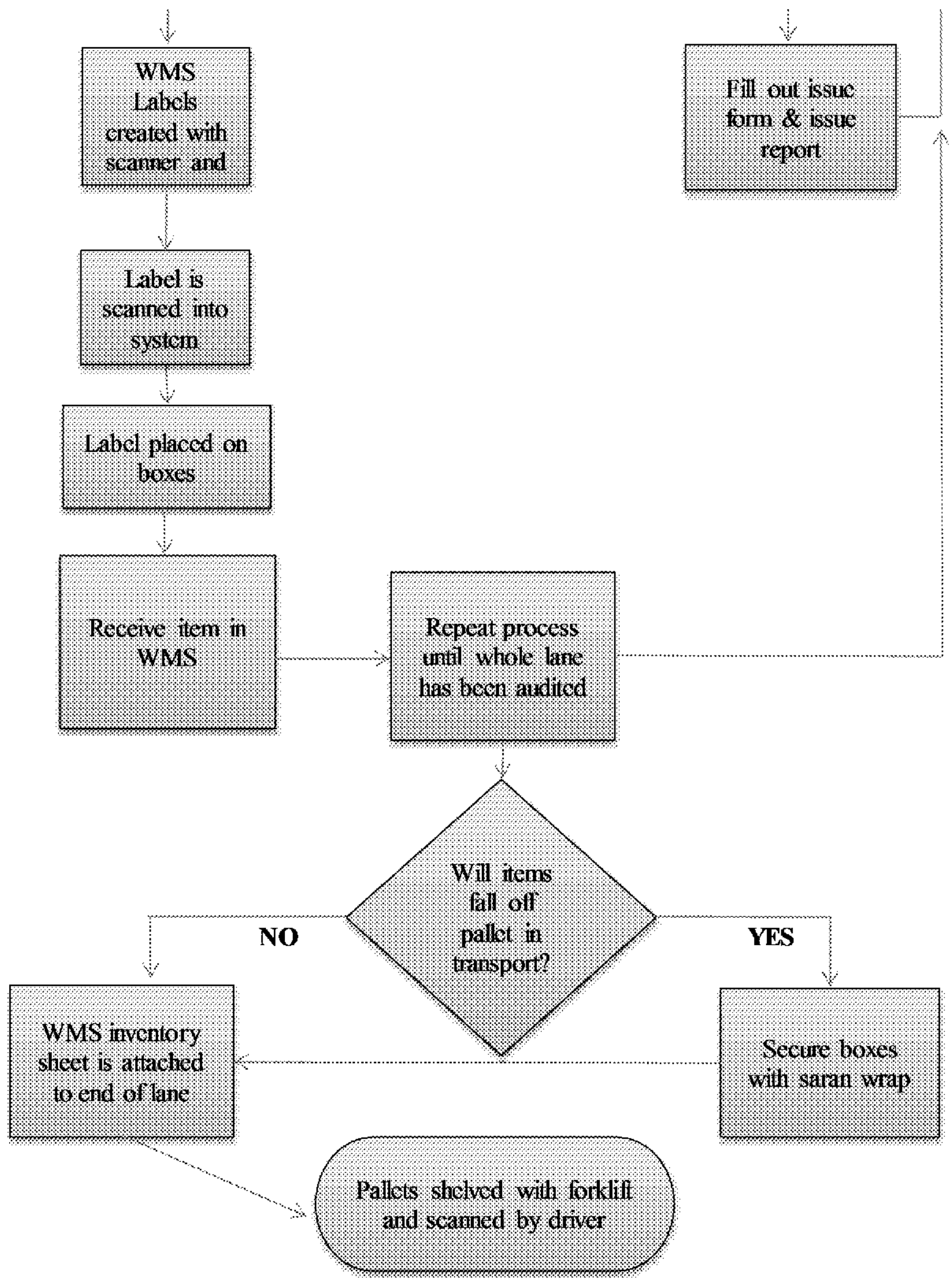
Note. Drawing is not to scale.

Appendix C

Proposed Receiving Process Flowchart

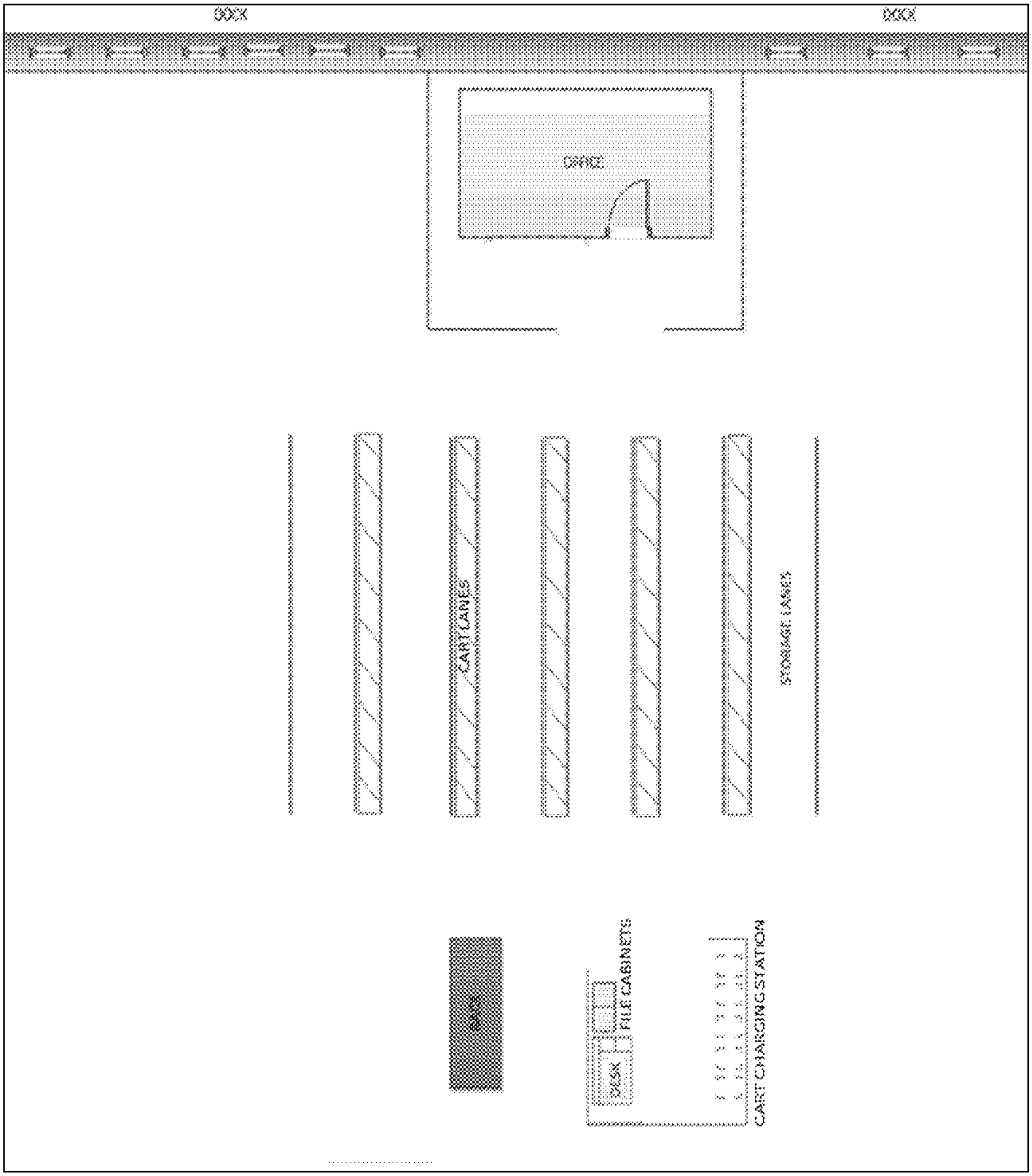


Appendix C (continued)



Appendix D

Proposed System Layout Visual



Note. Drawing is not to scale and is provided as a partial view of several newly structured lanes.