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Abstract

Optimizing/Benchmarking Returnable Container Processes within an Automotive Distribution System

An analysis of Reusable Packaging in automobile manufacturing facilities, as well as a comparison to other industries, shows that returnable container systems are not being fully utilized.

In this study, methods to return and track packaging materials for reuse are examined. Issues identified through surveys and interviews are summarized, and a recommendation to more fully utilize systems currently in place is proposed. An evaluation based on utilizing the current system will enable us to assign a cost to current operations, and may support an investment in improved systems and technologies.

Most of the companies surveyed gauge functionality based on whether or not there are shortages severe enough to stop production. This fact is determined through Gap Analysis, Benchmarking, and Case Studies. A process by which to track losses, costs, turnaround time, etc. of container return systems is currently not seen as a critical function of production, consequently no justification exists for investing in upgrading these systems.

A Closed Loop Packaging System refers to a well-defined circuit of shipping and delivery points. This closed circuit is essential to ensure that containers flowing through the system do not get lost (www.returnables.com). Locating and rerouting stray or replacing lost containers can be a significant, unplanned cost related to packaging returns. The automotive industry estimates a minimum of seven percent (7.00%) of automotive company budgets are spent replacing non-disposable containers and racks

(page 5 – AIAG 2008), therefore improvements to this part of the process could result in significant cost savings, and ultimately affect a company's bottom line.

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Introduction – Standardized Packaging Return System Analysis and Review

Closed Loop Packaging Systems are created to gain cost savings and deliver a product as efficiently as possible to the end user. The following questions are asked to determine the level of efficiency of a system:

- Can package return rates be measured accurately and consistently?

- How can return systems be improved with existing tracking and recording methods?

- What are the current methods in practice?

- Do these techniques improve transit time, packaging turnaround rates, and tracking accuracy, leading to additional cost justification of closed loop packaging systems?

This thesis provides a quantitative comparison of packaging reuse in automotive production by comparing the processes for return and reuse in other industries. In addition, the factors that determine whether to use returnables and the methods and challenges to track containers are presented.

Background

Generally, packaging designed for multiple trips is defined as reusable packaging. Most industries refer to multi-use containers as "reusable packaging, pallets or shipping containers." Reusable packaging is referred to as dunnage in the automotive industry, and is used to transport and deliver parts throughout the entire distribution system. The same package may be used for a part from the beginning of production at the supplier to the final installation on a vehicle or other automotive part.   Dunnage is used

repeatedly, returned and cycled through the system, with the intent of reducing packaging expenditures and waste.

A Closed Loop Container System refers to a well-defined circuit of shipping and delivery points. Returnables are defined as packaging or containers designed to be reused in manufacturing and distribution systems. They eliminate the need to purchase packaging which must be disposed of or placed in a landfill. Returnable containers can be designed to be more durable than corrugated or other expendable packaging for added protection.

Expendable packaging is usually designed and manufactured for single trips and short-term storage. It is disposable, and made of materials such as corrugated paper, plywood, or similar resources. The majority of products are packaged with expendable packaging. Sometimes expendable packaging is reused or recycled, turns (i.e. number of times packaging can be used) are less, and regular disposal of packaging materials is necessary.

Efficient container return programs benefit companies by reducing the long term cost of packaging. The recurring cost to purchase packaging is eliminated once the original outlay to purchase the containers is complete. Parts are well protected, packaging is standardized, and landfill waste is reduced.

Effective management of container inventories depends on the quality of data collection, resources and priorities at each location. Robust systems facilitate record management and asset tracking, account for volume fluctuations, reduce occurrences of misdirected containers, and prevent locations from holding or stockpiling containers to avoid shortages. Tracking systems may not be uniform between facilities, even within the same division of a company that processes similar parts from the same source.

Issues that cause a closed loop system to be less effective are:

- shrinkage due to damage

- transit times different than calculated

- banking excess parts

- not having a sufficient amount of packaging (due to an increase in production or not enough ordered originally)

These issues lead to increased, unbudgeted costs such as non-scheduled trucks, late shipments and line stoppages. Unbudgeted packaging costs include repacking and use of non-standard packaging.

Returnable shipping containers should be considered a corporate asset rather than an expensed item. Since packaging has always been considered an expense, thinking of packaging as a long-term asset is a new idea for most packaging and logistics professionals. Even suppliers of returnable containers usually emphasize the packages' payback period rather than their profit potential. (Rosenau, 1996)

Packaging Components - Definition

Per the Institute of Packaging Professionals IoPP Glossary of Packaging Terminology: dunnage is defined as (a) any blocking, lining, strapping, tie-downs, or similar bracing or support used to hold a load in position during shipment. In some transport vehicles, adjustable braces and barriers are a permanent fixture.

(b) Sometimes loosely applied to cushioning materials placed into the interior of a package to protect fragile articles from shock and vibration. (Soroka)

Returnables are packaging or containers designed to be reused in manufacturing and distribution systems. The need to purchase disposable packaging, which must be routed to a landfill or recycled, is eliminated or reduced. Returnable packaging can be designed to be more durable than corrugated or other expendable packaging for added protection and increased life through the distribution system.

Expendable packaging is generally designed and manufactured to protect products destined for single trips and short-term storage. It needs to be disposable, made of materials such as corrugated, plywood, paper or similar materials that can be land filled or recycled. The majority of consumer goods are packaged with expendable packaging. These types of products and packs are traditionally viewed in most manufacturing industries as single use packaging. Sometimes, expendable packaging is reused or recycled. This means that turns are fewer compared to returnable packaging, and a regular disposal process for packaging materials must be incorporated in the lifecycle of the packaging and manufacturing process.

Packaging Return Systems – History

One of the first applications of packaging reuse in automotive production was put into practice by Ford Motor Company. Ford's Rouge Returnable Container return department was in place as early as 1930. Parts were received in special crates so the wood could be reused to make bumpers and running boards for vehicles (Thomas, 2001).

The use of returnable packaging increased when many companies began to use plastic pallets and containers regularly for reuse after 1985 (Grande, 2008). Industries incorporating returnable packaging into their manufacturing and distribution processes include Automotive, Produce and Dairy, Beverages, Chemicals, Medical Device, Computers/Electronics/Technology, Postal and Small Parcel Delivery, Military, and Fiber Optic/Communications Cable. Manufacturers that do not commonly practice container return programs are consumer based, such as end user Pharmaceutical, Medical Device, food and consumer goods. These packs are intended to protect, preserve and/or dispense the product directly to the end user.

Closed Loop Packaging Return Systems can be an integral part of the Lean Manufacturing Process. Lean Manufacturing is a business system used to organize and manage product development, operations, suppliers, and customer relations. Business and other organizations use lean principles, practices, and tools to create precise customer value of goods and services, with higher quality and fewer defects, all with less human effort, space, capital, and time than the traditional system of mass

production. (www.lean.org) Returnable packaging fits into Lean Manufacturing because it delivers   material to customers with robust packaging that is designed to protect specific parts while reducing expenditures.   The effective use of returnable packaging systems requires a structured and organized method that aids in part delivery; this ties directly into the Lean Manufacturing Process.

Methods

A combination of qualitative and quantitative methods is used to evaluate container return systems within the automotive industry. These methods are also used to compare and contrast the systems to those of other industries.

- Quantitative Research – Non-Experimental Design and Evaluation
- Qualitative Research – Case Studies (Determination of System Robustness)

Quantitative Research

Non-Experimental Design, Comparison, and Evaluation are methods of research which are used to determine whether a program or project researched for this thesis follows the prescribed procedures and achieves the stated outcomes.   The methods outline existing needs and environments, i.e. Gap Analysis (C Δ V - Current vs. Vision - where we want to be/Kanban) and Value Stream Mapping (Current State vs. Future State) are utilized to gather information and evaluate the effectiveness of closed loop container return systems.

Three surveys are conducted for the purpose of this thesis to identify common characteristics, processes, cost analysis, as well as strengths and weaknesses of returnable container systems. Using the surveys' results, the beliefs and observations of specific groups are identified, reported and interpreted.

Qualitative Research

Case Studies give a background of systems, development and history, and explain current conditions as described by subject matter experts. This data is used to give detailed feedback on existing systems. A Case Study attempts to shed light on phenomena by studying, in-depth, a single example. The studies, obtained through literary reviews of case studies, professional experience, and a single personal interview, combine benchmarking, and detail the process through a Gap Analysis. Automotive container return systems are compared to processes instituted in other industries that are similar and manage reusable packaging programs.

Methodologies to Determine Robustness of Systems

Gap Analysis

The Gap Analysis lists, describes, and prioritizes the current state as well as future requirements desired in closed loop returnable container system. The C Δ V section, Current versus Vision, illustrates where the organization wants to be in regard to the system under study. This analysis determines whether a gap exists between the current state and the future requirements. Once gaps are established, the next step is to ascertain if the solution meets future requirements. If the analysis reveals the

solution meets the needs, it indicates the process under evaluation will be implemented with a higher level of success than the current method in use.

A Gap Analysis is a tool used to define requirements, rank priorities, set goals, plan, and execute changes in existing processes, or develop brand new systems to replace existing processes. Employing this method enables organizations to make decisions based on data analysis, surveys, actual costs, etc. The more detailed a GAP analysis is, (i.e. one which includes historical data, data on existing processes, as well as competitors' processes) the greater the chance of setting up a system according to true requirements, so that all pitfalls and potential problems are minimized.

There are three main objectives of the study:

1. Define the ideal state, desired results;

2. Pursue questions which will guide decision makers to the desired results and eliminate unwanted and unproductive issues;

3. Make an informed decision and conduct process implementation based on the framework provided during the examination process.

The Gap Analysis consists of the following sections:

1. Requirements or Needs
2. Questions
3. Points of Change
4. Desired Results

Each section of the analysis contains a consistent set of questions related to the desired state or end result.   For this study, the selected questions are categorized in terms of:

- Complexity
- Cost
- Commonality
- Protection
- Tracking
- Routing
- Availability
- Lean Manufacturing

The Requirements/Needs section lists key requirements from the research, and are categorized related to performance and improvements of returnable container loops. Each requirement has an indicator of whether the organization's current solution meets that requirement, and whether the aspects researched will meet that requirement in the future.   Based on benchmarking, surveys, the interview, and data of excess charges within one automotive company's container return system, the following factors were listed as conditions or criteria that affect the ability of systems to meet future requirements:

- Quantity of Parts in returnable packs
- Expendable container needs
- Shortages of packaging
- Common returnable containers
- Return rate
- Expected rate of loss/time
- System days
- Transit Time

- Route

- Misrouted loads

- Transportation Mode

- Number of Distribution Centers

- Customs Issues

- Volume Fluctuation

- Costs/Investments vs. Payback

- Custom packaging vs. standard totes

- Who should manage container tracking records/ who are responsible parties?

- What methods are used to track dunnage?

- Other Issues/Requirements

GAP Analysis Needs

Business Objective		Current State (Where We Are)	
Complexity	1	Ratio of parts Stock Keeping Units (SKUs) to number of packs minimized	No
	2	Customized packaging or dunnage only when necessary	No
Cost	3	No excess charges for back up packaging due to shortages	No
	4	No expedited loads	No
Commonality	5	Utilize stock packaging to achieve uniformity	No
	6	Dunnage or pack shared between parts if parts fit in same pack	Yes
	7	Expendable packaging used when best option for cost and protection	No
Protection	8	Product does not sustain damage during distribution	Yes
	9	Pack is durable and has unlimited turns	Yes
Tracking	10	Scanning or Radio Frequency ID (RFID) tags used to track dunnage/returnable packs	No
	11	Real Time tracking	No
	12	Inventory up to date & reports accurate	No
Routing	13	Routing established	Yes
	14	Accurate transit times	No
	15	Direct ship or single DC <1 day transit time	Yes
Availability	16	Minimum inventory of empty returnable packaging	No
	17	Pack availability does not fluctuate with volume	No
	18	Return rate high, loss rate <5% (no production stoppages)	Yes
Lean Manufacturing	19	End use/operator presentation meets needs	No
	20	Between 1 and 4 hours of material per container	Yes
	21	Pack weight meets ergonomic standards	Yes
	22	JIT delivery of packaging	No
	23	Pack provides visual aid for replenishment	No

Table 1: Gap Analysis Needs, requirements outlined to begin definition of process status and needs

The Questions Section outlines the desired outcome of the characteristics defined above. This describes what is preferred, and how the system should be designed. The criteria listed in the Requirements section is used as a guide for operation of the process. While the Requirements Sections describes the current state, the Questions Section defines which of these factors is needed or what conditions to avoid.

GAP Analysis - Questions

Business Objective		Desired (Where We Want to Be)	
Complexity	1	Ratio of part SKUs to number of packs minimized	Yes
	2	Customized packaging or dunnage only when necessary	Yes
Cost	3	No excess charges for back up packaging due to shortages	Yes
	4	No expedited loads	Yes
Commonality	5	Utilize stock packaging to achieve uniformity	Yes
	6	Dunnage or pack shared between parts if parts fit in same pack	Yes
	7	Expendable packaging used when best option for cost and protection	Yes
Protection	8	Product does not sustain damage during distribution	Yes
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Tracking	10	Scanning or RFID tags used to track dunnage/returnable packs	Yes
	11	Real Time tracking	Yes
	12	Inventory up to date & reports accurate	Yes
Routing	13	Routing established	Yes
	14	Accurate transit times	Yes
	15	Direct ship or single Distribution Center <1 day transit time	No
Availability	16	Minimum inventory of empty returnable packaging	Yes
	17	Pack availability does not fluctuate with volume	Yes
	18	Return rate high, loss rate <5% (no production stoppages)	Yes
Lean Manufacturing	19	End use/operator presentation meets needs	Yes
	20	Between 1 and 4 hours of material per container	Yes
	21	Pack weight meets ergonomic standards	Yes
	22	JIT delivery of packaging	Yes
	23	Pack provides visual aid for replenishment	Yes

Table 2: Gap Analysis Questions, designed to narrow system requirements

The Points of Change section highlights areas that meet the required needs, specifies what requirements are unmet, and what is needed to meet the requirements in those areas, based on the original criteria. The areas that do not meet identified needs represent gaps found during the analysis.

GAP Analysis - Points of Change

	Needs & Questions	Disparity	Desired Results
1	Ratio of part SKUs to number of packs minimized	YES	Similar parts are consolidated, part numbers used for various end items
2	Customized dunnage only when necessary	YES	Dunnage is designed to enhance use of the part on line by the operator or automation
3	No excess charges for back up packaging due to shortages	YES	Sufficient amount of packaging is available to avoid fees additional costs for emergency dunnage or repacking
4	No expedited loads	YES	Packaging delivered on scheduled routes, no arrangement of special deliveries to meet production
5	Utilize stock packaging to achieve uniformity	YES	Reduced costs for tracking and sorting of dunnage
6	Dunnage shared between parts if parts fit	No Gap	**Meets Needs**
7	Expendable packaging used when best option for cost and protection	YES	Expendable packaging can be managed and recycling can be planned
8	Product does not sustain damage during distribution	No Gap	**Meets Needs**
9	Pack is durable and has unlimited turns	No Gap	**Meets Needs**
10	Scanning or RFID tags used to track dunnage	YES	All tracking data captured automatically
11	Real Time tracking	YES	Tracking data accurate and immediately to all container users in system
12	Inventory up to date & reports accurate	YES	Tracking data accurate to assist all container users in system
13	Routing established	No Gap	**Meets Needs**
14	Accurate transit times	YES	**Meets Needs**
15	Direct ship or single DC <1 day transit time	No Gap	**Meets Needs**
16	Minimum inventory of empty dunnage	YES	Need for excess dunnage to cover production shipments eliminated
17	Dunnage availability does not fluctuate with volume	YES	Packaging flow is level and does not need to be tracked down as volumes increase or decrease
18	Return rate high, loss rate <5% (no production stoppages)	No Gap	**Meets Needs**
19	End use presentation meets needs	YES	Operator can access part on line for installation
20	Between 1 and 4 hours of material per container	No Gap	**Meets Needs**

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21	Pack weight meets ergonomic standards	No Gap	**Meets Needs**
22	JIT delivery of packaging	**YES**	Packaging delivered to production line when needed
23	Dunnage provides visual aid for replenishment	**YES**	Operator and delivery driver are able to determine when additional parts are needed, preventing shortages

Table 3: Gap Analysis Points of Change outlines areas that do not meet requirements

The last section, Desired Results, describes the ideal end result for all criteria, based upon the original needs summarized when the study was initiated. The objectives and criteria remain constant throughout the study as requirements are defined and areas are identified as meeting the criteria, or a gap remains. This information is used to develop a framework to build a system or environment that meets all the needs.

Desired Results

1	Similar parts are consolidated, part numbers used for various end items
2	Packaging is designed to enhance use of the part on line by the operator or automation
3	Sufficient amount of packaging available to avoid fees additional costs for emergency packs or repacking
4	Packaging delivered on scheduled routes, no arrangement of special deliveries to meet production
5	Reduced costs for tracking and sorting of returnable packaging
6	Packaging can be utilized for multiple parts, reducing complexity
7	Expendable packaging can be managed and recycling can be planned
8	Product is sufficiently protected and received in good condition
9	Container withstands the rigors of distribution for the life of the product or program
10	All tracking data captured automatically
11	Tracking data accurate and immediately to all container users in system
12	Tracking data accurate to assist all container users in system
13	Path or route of returnable packaging is stable, can be predicted, and used to forecast
14	Transit times in system are correct, enabling OEM and end users to forecast shipments and receipts
15	Route for packaging is simple and streamlined, eliminating need to store or procure excess, backup packs
16	Need for excess dunnage to cover production shipments is eliminated
17	Packaging flow is level and does not need to be tracked down as volumes increase or decrease
18	Containers arrive to desired location when needed for packout and shipment for production
19	Operator can access part on line for installation
20	Operator has sufficient amount of material for continuous use
21	Package full of parts can be lifted and moved easily by operators
22	Packaging is delivered to production line when needed
23	Operator and delivery driver are able to determine when additional parts are needed, preventing shortages

Table 4: Gap Analysis Desired Results lists all requirements of system if fulfilled

Measures

Surveys

Levels of effectiveness of container return rates and efficiency in closed loop systems are measured based on: return rates, measured costs, loss, and production interruption. The methods to create these measurements will be: Gap Analysis – points of change to gain improvements in return rates, and Survey Results/Statistical Data – major influences identified and noted in the survey.

Return Rate is an approximation of the number of pieces of packaging within the system at any given time. This quantity is based on the replacement rate, how many packs are lost due to misroutes, delays, and damage. This helps to determine how much packaging is needed over the life of the product. Loss – shrinkage due to misroutes, packs not reintroduced into system, and breakage contribute directly to the return rate.

There are various types of initial and ongoing measured costs. Capital investment is an initial cost, based on calculated needs. Pack replacement due to loss, as well as shipping, warehousing, and back up packaging purchases are ongoing costs. Ongoing costs vary, depending on the complexity of the system, and how the loop or return system is managed. Some costs are not directly related to the purchase of packaging, but are due to other packaging factors, and increase the costs of manufacturing. For example, production stoppages caused by a shortage of packaging that prevents part shipment can lead to customer delays. This can be difficult to capture

from a cost standpoint, since it is not a standard entry in production reports or cost structures. Many times, interruptions in manufacturing have multiple contributors, and companies may not have a way to attribute the cause and cost to a packaging issue in their accounting systems. Loss in terms of production can be quantified, however understanding how much of that cost is due to an inadequate amount of packaging, excessive attrition, or misrouting is more difficult.

Case Studies and Industry Analysis

Case studies based on literature reviews involving packaging systems for five automotive industry companies are evaluated and summarized. Each company is evaluated on the basis of usage of returnable containers to ship automotive or similar parts. These studies were selected after completing literature searches documenting companies that produce automotive or similar parts with established returnable container practices within closed loop systems. Additionally, three other industries that reuse packaging are analyzed and included as case studies, based on literature reviews. Each company is evaluated on the basis of usage of returnable containers to ship products. These studies were selected based on professional experience, as well as literature obtained through research of company processes, trade journal articles, and white papers of studies related to returnable containers and systems for packaging returns.

Case Studies

Automotive

When feasible, common containers such as totes, trays, pallets, and rigid intermediate bulk containers are used within a return system to maximize shared costs. Returnable packaging is used to present parts in lineside displays, and as part of the production process. Lineside displays are workstation setups with mini pick stations placed at the point of part installation. The parts are available to operators in packaging designed to act as a dispenser, or to be loaded for integration into the workstation. Lineside displays hold a designated number of parts used in a pull system/Kanban based on usage to aid in ordering, thus minimizing inventory levels by providing visual alerts for replenishment and error proofing.

Distribution centers and direct route shipments provide one method to deliver packaging through the closed loop system. Distribution centers may warehouse containers; however in automotive production, the goal is to provide packaging on a just-in-time basis (JIT). Cross-docking in distribution centers, and direct shipments from supplier or OEM to assembly plants are used more often to move packaging through distribution centers, versus long-term storage in warehouses. Tracking numbers, RFID tags, key entry information, and barcodes are used to locate packaging when necessary, or provide real time inventory information to assist in supplying containers to the appropriate facility as needed.

New United Motor Manufacturing, Incorporated

New United Motor Manufacturing, Inc. (NUMMI) is a joint venture between Toyota and General Motors. NUMMI reduces corrugated consumption 60% by purchasing, using, and requiring suppliers to deliver parts in reusable containers. Almost all parts shipped to NUMMI are transported in returnable containers, saving millions of dollars. Protective plastic packaging is returned to suppliers for reuse, resulting in an annual savings of $99,000. (Gilmore 2001)

Toyota Logistics Services (TLS)

TLS customizes vehicles for purchase after assembly. Carpet is shipped in one-time-use corrugated boxes on pallets. Toyota Logistics Services has replaced corrugated containers with large reusable plastic containers that collapse, stack, and can be transported pallet-free. This change has eliminated 3,000 tons of combined wood and cardboard waste and saved $3.5 million in expendable packaging for six (6) facilities annually. (www.stopwaste.org, 2005).

TLS also installs custom floor mats in assembled vehicles. Expendable packaging has been replaced with returnable totes to achieve an annual savings of $28,000. The savings included annual container costs of $3,500 (amortized over 4 years) and a net annual savings $24,500. Corrugated use has been decreased by 17,000 pounds per year, and 37,000 pounds fewer wooden pallets are used. The labor to process the return packaging was determined to be equivalent to the previous cost to process and dispose of the original, expendable packaging. (Allaway, 2005)

Automotive Valve Trays

Returnable Valve Trays are manufactured for use by Eaton, a major supplier of engine valves in the Midwest United States. Parts are produced in Nebraska, packed in returnable trays, and shipped to various automotive companies, located in Canada, Michigan and elsewhere. The trays are custom designed for automated picking and placement on engine assembly lines, and are strong enough to withstand unlimited trips between the supplier and end user. The trays are labeled and color-coded for easy identification and proper routing. (Whitt, Material Handling Management)

John Deere Industrial Vehicles & Parts

This manufacturer of industrial vehicles and farm equipment routes company owned packaging through designated distribution centers in a closed loop returnable container system in the industrial division. The system is highly controlled; containers are tracked via software, RFID tags, and scanning. Each container is scanned as it is received through designated points in the system. John Deere uses a computer system named ContainerMate. This program captures information for every container, such as inventory levels and inventory turns, provides tracking to locate lost containers, and gives container shipment requirements in addition to container cleaning and repair statistics. (Claasen, 2005)

John Deere Turf Care

This division of John Deere set a goal to stop using non-returnable packaging in order to achieve cost savings. Turf Care containers were bought and distributed within their division. The Turf Care unit decided to utilize the Corporate Pool of containers, described above. John Deere's Worldwide Logistics (WWL) group manages this returnable system. This program is focused on making generic Deere containers that can be sent to any Deere unit, and containers are replenished from strategically located areas. Deere is still working on the implementation; some units will always manage and replenish their own containers (Horicon, Greeneville, and Augusta).

Food Products

Packaging for food and food processing is mainly single use. Most food is packed specifically for use by the final consumer. The following products are examples of food items commonly transported in a closed loop packaging system. Agricultural and meat products such as fruits, vegetables, and seafood may be shipped in Returnable or Reusable Plastic Containers (RPC). General guidelines for these returnable containers are compiled and made available by the Reusable Container & Pallet Association (RCPA). RPC Case Studies have been conducted by the Stopwaste Partnership to demonstrate how the use of Reusable Plastic Containers (RPCs) can increase profit above the typical one percent margin (stopwaste.org/partnership, 2002).

Grocery (TPS JIT Benchmark)

Piggly Wiggly is the first self-serve supermarket, and was utilized as a JIT benchmark by Toyota when the Toyota Production System (TPS) was in development (Ohno, 1995). The grocery store only replenishes items as customers purchase them, versus ordering based on purchase forecasts. This system of picking and ordering as products are consumed became the basis for the TPS, which emphasizes tracking and responses based on real time events. Other Grocery related Industries that use returnable and reusable packaging include: Seafood, Bread, Produce, Dairy/Beverage/Soft Drinks, and a limited amount of home delivery for dairy products.

Technology – Electronic Wire and Cable

Wood reels are collected and refurbished or recycled by cable manufacturers. The end user ships reels back from job sites to the reel supplier. The reel supplier inspects each reel and repairs, if needed, based on pre-determined criteria. Once inspection is complete, the reels are marked with a code to signify repair and the number of turns. The cable manufacturer pays to ship used reels to the single repair facility, thus ensuring most reels remain in the return loop and complexity is reduced.

Technology – Computer Components and Hard Drive Manufacturing

Server hard drives are packed in corrugated boxes with Polyurethane foam inserts. The parts are packed by the Outside Equipment Manufacturer (OEM), and shipped approximately 15 miles to the customer facility for final assembly and configuration. The customer removes the drives at the production facility, and the packs

are transported back to the OEM for inspection and reuse. The corrugated portion of the pack is durable enough to withstand a minimum of five turns. The PU insert is more durable, and can be cycled an indefinite number of turns. The number of corrugated turns is tracked by marking a pre-printed grid on the bottom of the box. There is one design for the pack and the route is direct, so there is no complexity in this closed loop process.

Small Parcel - United States Postal Service

Corrugated plastic totes, or tubs, and plastic pallets are used to transport letters, small packages and bulk shipments through the United States Postal Service system. Totes remain within the USPS, or are shuttled between final destinations and the local post office (e.g. a shipping department or mailroom of companies processing bulk deliveries or significant mail volumes). Because of the high volume of totes and pallets utilized, and the relatively low cost to purchase the packaging, the cost to track with RFID technology cannot be justified. The Post Office relies on their end users and customers to return packs on their own. Occasionally, the USPS will promote mass returns through amnesty programs that will not penalize customers who hold returnable containers and use them for non-postal related applications. This enables them to recapture pallets and totes previously removed from the return loop by customers at a level that meets their requirements. It also allows customers to return the containers and pallets without fines or other penalties, and reduces the cost when repurchases are made. (www.mhmonline.com, 2006)

Small Parcel Distribution Systems - Includes Air Shipment Containers, Smalls Shipments

Small packages are placed in reusable bags or canisters, which are routed and redirected through the small parcel distribution system. Durable bags and totes are standardized so they can be used in any location, if necessary, as needed. Canisters, large custom containers made to fit in cargo planes, are used in aircraft, and stay with designated aircraft, while customer parcels are unloaded and shuttled between airports and distribution hubs throughout the country.

Industry Analysis

Questionnaires

Questionnaires were used to gather data regarding tracking, distribution cycles, and desired features of closed loop system for returnable automotive and industrial containers. Three unique questionnaires were distributed via "Survey Monkey" to 317 contacts at 98 different companies. Surveys were sent via email from November 21, 2008 to February 26, 2009, and collected until May 13, 2009. Each survey consisted of 10 questions, and the employee segments are as follows:

- **Returnable Container Tracking**
  - Target population – part suppliers to end user of parts shipping returnables and receiving empty returnable packs for reuse

- **Returnable Container Factors**

  o Target population – packaging designers, container maintainers and managers, corporate information system users, and distribution center personnel utilizing returnable packaging data for their job

- **Distribution Cycle**

  o Target population – employees in distribution centers, responsible for shipments, cross docking, and routing of returnable containers

| Summarization of Questionnaire Responses and Return Rates					
Survey Description	**Responses**	**Sent**	**Return Rate**	**Companies**	**Type**
Returnable Tracking - Tier1	17	78	21.8%	63	Tier 1
Returnable Tracking – OEM/Internal	36	224	16.1%	1	OEM
Returnable Packaging Factors	8	58	13.8%	20	Industrial
Distribution Cycle	6	65	9.2%	14	1PL
Grand Total	*67*	*425*	*15.76%*	*98*	

Table 5: Summary of three (3) questionnaire types, respondents, response rate, number, and type of companies surveyed

Survey Criteria	
Item	**Description**
Number of Parts/SKUs	Quantity of Parts in returnable dunnage/packaging - The amount of Stock Keeping Units (SKUs) can affect the type of returnable containers system that is selected and implemented
Expendable packaging needs	How is the determination made to use returnable packaging in a closed loop packaging system?
Shortage of stock containers	What causes container shortages?
Return rate/Expected loss rate	returnable packs throughout the supply and production cycle
System days/Transit Time	Amount of containers to be purchased for a closed-loop system can be based on several factors, time it takes to cycle the containers through the distribution cycle affects the amount of packaging needed to adequately supply the system and time it takes for packaging to cycle through the system one time is based on location, processing time
Route/Misrouted loads	Can be attributed to human error such as incorrect manual placement or key entry into a system that designates direction of containers
Transportation Mode	The mode of transport can affect transit time, handling environment, exposure to elements, cost, size of packs and pallet patterns
Number of Distribution Centers	Can determine the complexity of shipments, direct trucks vs. routing through multiple centers will increase handling, transit time, potential for lost containers, cost to handle, quantity needed to fill loop
Customs Issues	Transporting containers between multiple countries requires additional documentation and possible delays due to border inspections, paperwork errors, or expiration of documentation
Volume Fluctuation	Can lead to storage of containers during slower production intervals and possible shortages during peak production times
Costs to set up and maintain closed loop return system	Initial investments of packaging, equipment and systems and must be compared to the time it takes for payback. Each company must determine an acceptable timeline for recovery of their original expenditure. The justification of the ongoing return process must considered and outweigh the total cost to purchase and the resources set up the structure
Determination should be made regarding type of packaging used to transport containers	Custom packaging can be designed to accommodate the specific needs of the product and the environment. Standard packaging, such as stock totes or plastic pallets may be suitable and offer more flexibility.
Container tracking records	A key element of container return systems
Tracking of containers	Can be accomplished various ways. Manual records, barcode scanning and RFID are methods to capture quantities and location of containers

Table 6: Factors listed above were used to determine the success of container return and management

Results

Standardized Container Return Statistics are summarized in charts below. Systems were ranked by users, and the methods utilized for returnable container tracking were recorded. Distribution cycles and key factors for returnable systems were also captured.
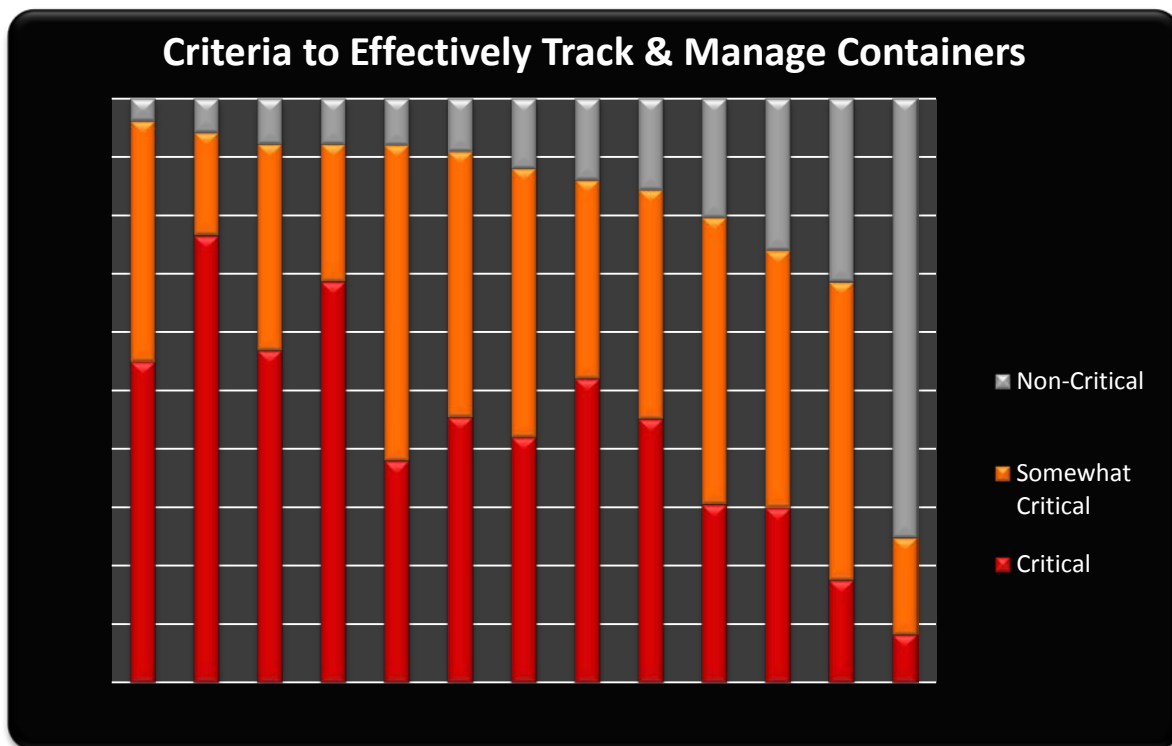
Graph 1: Ranking of criteria to determine effectiveness of container tracking systems by facilitators of returnable packaging receipts and returns at OEM facilities (end user of parts in containers)

Return System Measurements				
Location	**Excess Pack $**	**Stockpiling**	**Trailer Storage**	**Part Inventory**
Home	$210,000	N	N	Low
Highest Charges	$1,200,000	Y	Y	High
Lowest Charges	$150,000	N	N	Medium

Table 7: Comparison of Return Systems Based on Measures (cost, timing, etc.) - Intra Plant comparison
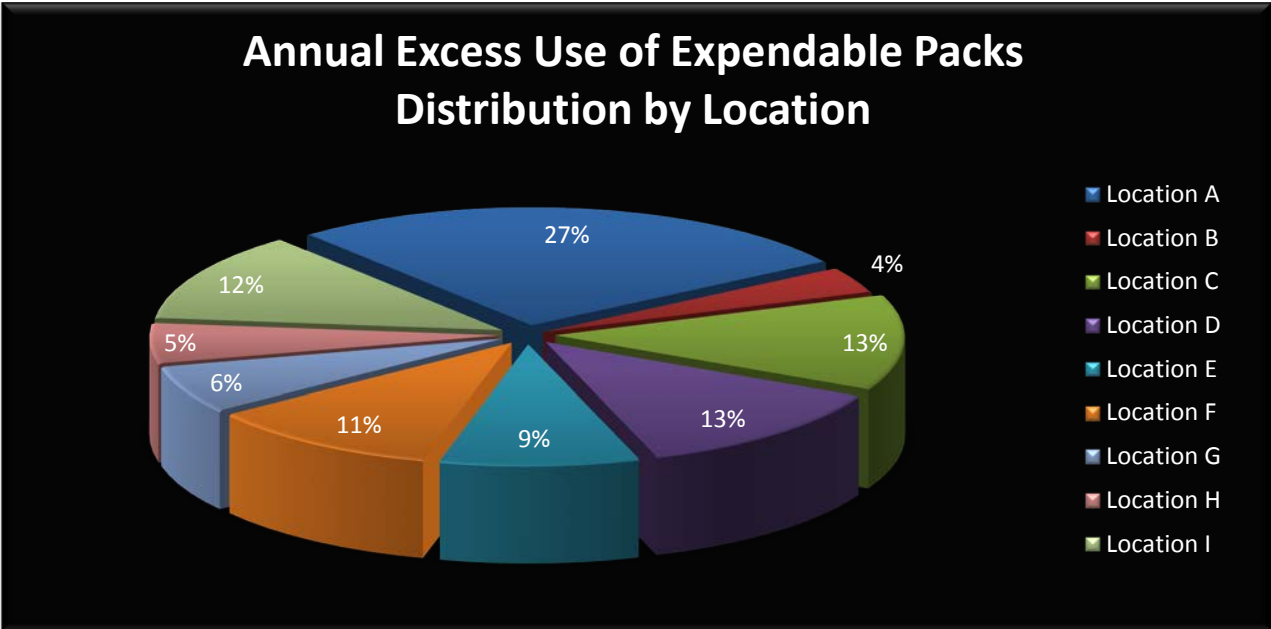
Graph 2: Expendable packaging used to replace lost containers or supplement shortages. The chart is broken down by each location to highlight the disparity between manufacturing facilities
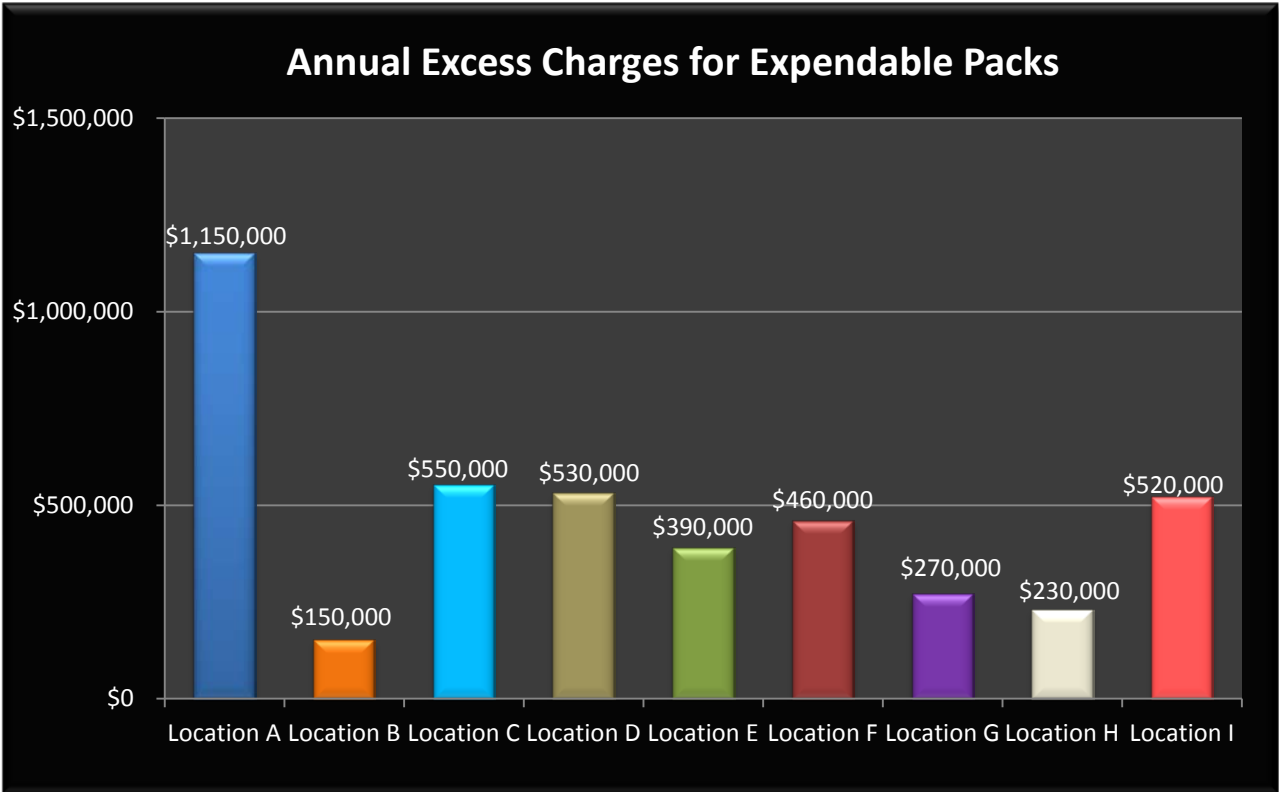
Graph 3: Summary of unplanned and unbudgeted charges spent to purchase expendable packaging when returnable containers are unavailable

Discussion

Previous studies were examined to determine if algorithms could be used to calculate the viability of container return systems. One such study was based on the premise that reusable containers require maintenance during their life, and they may need to be cleaned before re-using. (Yuan-Ting Cheng and Taho Yang 2005) These factors were taken into account for the analysis.   Damaged containers need to be repaired or replaced, plus the company implementing the use of reusable containers needs to keep enough empty containers in the loop to maintain production.

Storage space is also necessary, which leads to further costs. Additionally, costs for labor and equipment are incurred in moving and storing the containers. When a company switches to reusable containers, many of the company's costs related to handling, transporting, and tracking shipment and returning will be affected. In addition, the correct reusable containers must be returned to the company promptly, and in usable condition. Routes, frequency of reusable container shipments, and tracking of reusable containers, impact the return rate, All these factors must be taken into consideration in order for the data to be correct. The algorithm compares the costs for labor, container purchases, transportation and damage across various scenarios and concludes that a complete returnable system, such as a reverse logistics system, constructed properly with accurate data, can reduce expenditures related to transportation costs over the long run (Yuan-Ting Cheng and Taho Yang 2005).

The scenarios included:

1. 100% Corrugated use, recycled after use

2. 100% Corrugated use, disposed after use

3. 100% Returnable use (company owned), life cycle of three (3) years

4. 100% Returnable use (third party owned), life cycle of three (3) years

Reasons to Implement Return or Reuse Systems

- Cost effective

- Sustainable packaging

- Product Requirements

Possible Barriers or Reasons to Not Implement or Dismantle an Existing Return System

- Cost

- Systems & Tracking Accuracy

- Distribution Network

- Customer Acceptance
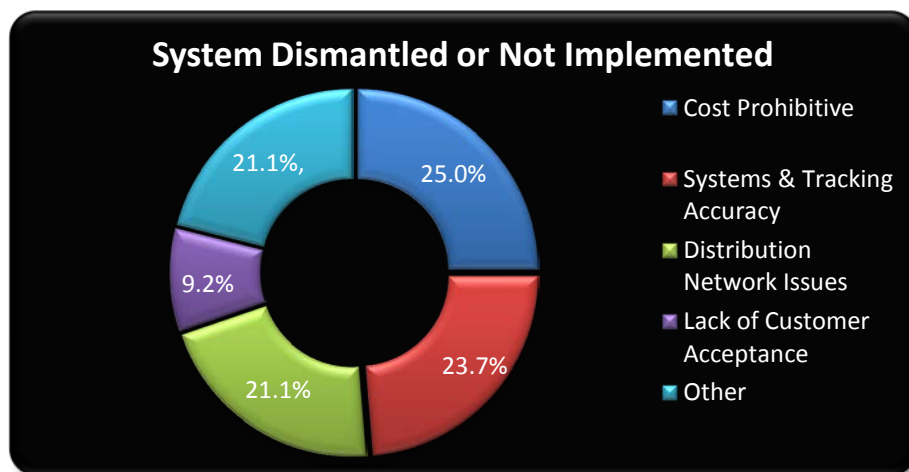
Graph 4: Reasons cited to dismantle an existing container return system or justification to not pursue a return system

Conclusion

Reusable Packaging Analysis (analyzing methods and materials/dunnage for reusable packaging, identify issues, determine improvements, develop implementation plan) demonstrate that the issues are identified, but not resolved satisfactorily. Both of the original questions received negative answers in the surveys.

- Were container return rates improved or measured consistently with existing tracking and recording methods? No

- Did these methods improve transit time, packaging turnaround rates, and tracking accuracy, leading to additional cost justification of closed loop container systems? No

Overall, Closed Loop and Non-Closed Loop container return rates are not improved, nor are return rates measured consistently with existing tracking and recording methods. Although end users acknowledge tracking and related technology are proven methods to improve container return systems, in closed loops and non-closed loop systems, most users do not believe the cost of the process can be justified. Methods get bypassed during the container distribution process, so current systems are not fully utilized. However if fully utilized, delivery processes and returnable rates will improve.

Decisions are made to delay or not purchase additional technology primarily because the current systems being utilized, while not ideal, do not cause interruptions within the system severe enough to delay or halt production. This element is key to

determining whether any system is effective or acceptable. As long as the needed parts satisfactorily reach the end user when needed, the cost to add technology or system improvements will not be justified or approved.

Most industries, companies, and plants that currently track container returns use their systems to locate containers, but not necessarily to track or capture savings, losses, or other ongoing costs related to the container return program. If new systems are purchased, costs and savings may eventually be shown to be cost effective enough to justify the initial investment or container replenishment quantities. Ongoing, companies should continue with data collection and tracking in order to capture and analyze costs for scheduling, repairs, cleaning, etc. This will help determine if there are ongoing costs advantages, or if upgrades are necessary or justifiable.

Appendices

A – Background – exploratory question used to develop Gap Analysis, surveys, and resultant data

Survey Question formulation, areas of exploration

- Ease of data entry

- Problems entering data

- Ability to accommodate multiple users

- Ease of generating reports

- Accuracy of reports

- Ability to generate program section of [Insert here]

- Ability to generate unduplicated count

- Training

- Satisfaction

- The effectiveness of training

- Usefulness of support

- Overall quality of the software

- Overall accuracy of the reports

- Key points to making returnables work

- Cost and savings in a returnable system

How can you be sure the returnable isn't contaminated? How does it apply to temperature controlled products? (Lindquist)

Survey 1 – Returnable Dunnage Factors

1. What type(s) of returnable containers are used at your facility? The types of packaging used contribute to success of returning packaging. Standard versus custom design determine whether packaging can be shared within a facility with numerous parts, or if containers can be shared between facilities. Costs can be saved if sharing containers by utilizing stock packaging is important. Identifying specific parts or containers within a system would lead to a decision to use customized packaging. Pallets can be custom designed to meet the needs of specific distribution networks, based on product protection, cube utilization, special identification, and specialized applications.

2. What materials are utilized for your returnables? This question helps gauge the robustness, and level of customization or standardization. For example, wood pallets are subject to breakage and need repairs, such are replacement of stringers. Plastic pallets will be utilized for more turns, most likely the life of the product or several products. Injection molded, thermoformed or metal packages can be designed for specific uses, such as dispensing or strength, while corrugated plastic may be used for applications such as totes or standard sized boxes. Standardization implies more universal use of containers and less complexity in the closed loop system.

3. Rank these factors in order of importance when making a decision to implement a closed loop container system. (Most Important, Very Important, Somewhat Important, Less Important, Least Important)

- Capital Investment

- Cost for Tracking and Accounting

- Environmental Impact

- Logistics and Warehousing

- Transportation vs. Packaging

4. Rate criteria listed as (1 - Non-Critical, 2 - Neither, 3 – Critical, N/A)

- Number of Parts/SKUs

- Part Protection Part

- Dunnage Shortages

- Return Rate

- Transit Time

- Misrouted Shipment

- Distribution

- Customs/International Shipments

- Volume Fluctuations

- Payback

- Systems/Tracking

- Scanning Capabilities

- Other - Describe

5. Which factors are important when tracking assets? (Very Useful, Useful, Not Useful)

- System/Technology

- Scanning/Bar-coding

- Data Accuracy

- Real-time Data

6. Do any of the factors contribute to the choice of returnables as the packaging of choice? If so, specify whether it is for functional or cosmetic reasons?

- Shock/Impact

- Temperature

- Moisture

- Compression

- Vibration

7. Has the environmental impact in your organization been defined or measured?

- Yes

- No

8. What is your annual returnable loss rate? (damaged or never returned) Based on the survey results, most packaging is not tracked for level of returns, but estimated to be less than 5.00%. In turn, the return rate was not considered to be an issue until there are production stoppages due to container shortages.

9. Please provide your contact information

Contact information was requested in case clarification was necessary; the ZIP codes were also noted for distribution purposes and are mapped below.

Illustration 1: Returnable Dunnage Factors Survey Respondent Location Plot

10. What is your industry?

- Automotive/Produce/Technology/Dairy/Soft Drink/Beverage/Other (please specify)

    B – Desired Features of Dunnage Return Systems (Questionnaire)

Survey 2 – Distribution Cycle

Illustration 2: Distribution Cycle Survey Respondent Location Plot

Survey 3 – Dunnage Tracking

Illustration 3: Dunnage Tracking Survey Respondent Location Plot

Graph 5: Survey Participants – type of facility within returnable container loop

Returnable Tracking Facility Type

All of the Above
29.4%
29%

Distribution Center
19.6%
20%

Production Facility
15.7%
16%

Automated System
23.5%
23%

Data Center/IT
11.8%
12%

Third Party
0.0%
0%
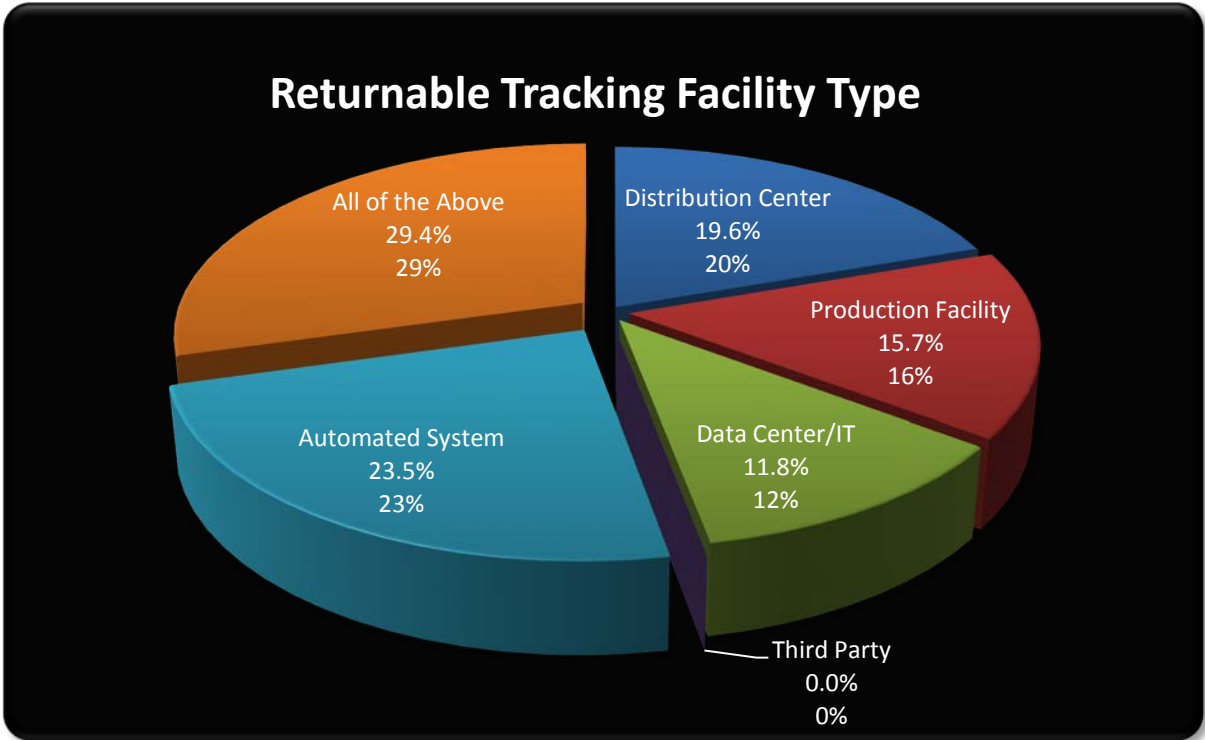
Graph 6: Distribution Cycle Survey Respondent Breakdown of Types of Tracking

Tracking Methods

Software/ERP,
49.0%

Manual/Paper,
33.3%

Other/Kanban, 9.8%

Bar Code Scanning,
5.9%

RFID Scanning, 0.0%

No Response, 2.0%
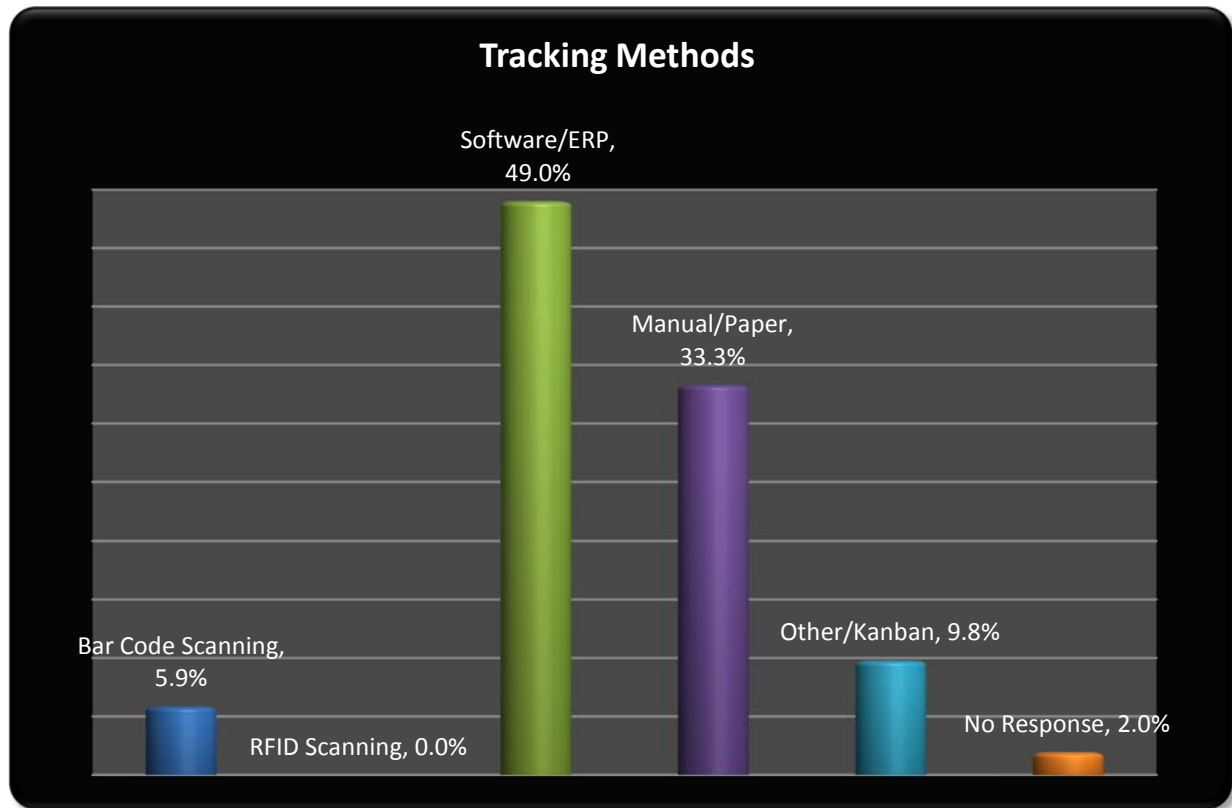
Graph 7: Level of Tracking System Effectiveness

Tracking System Effectiveness

No Response
2.0%
2%

Very Effective
17.6%
18%

Not Effective
23.5%
23%

Somewhat Effective
56.9%
57%

■ Very

■ Somewhat

■ Not

■ No Response
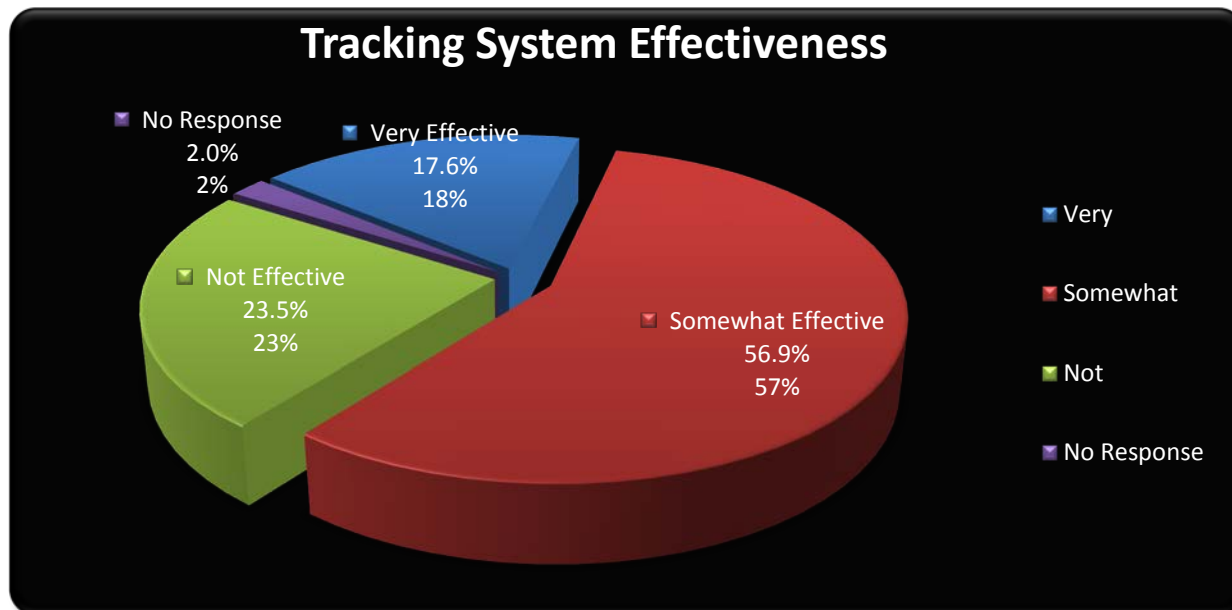
Graph 8: Distribution Cycle Survey Respondent Breakdown of Types of Tracking

Calculated vs. Actual Tracking Times

No response
2.0%
2%

No
17.6%
18%

Yes
80.4%
80%

- Yes – accurate enough to meet production needs
- No – not consistent enough to meet production needs
- No response
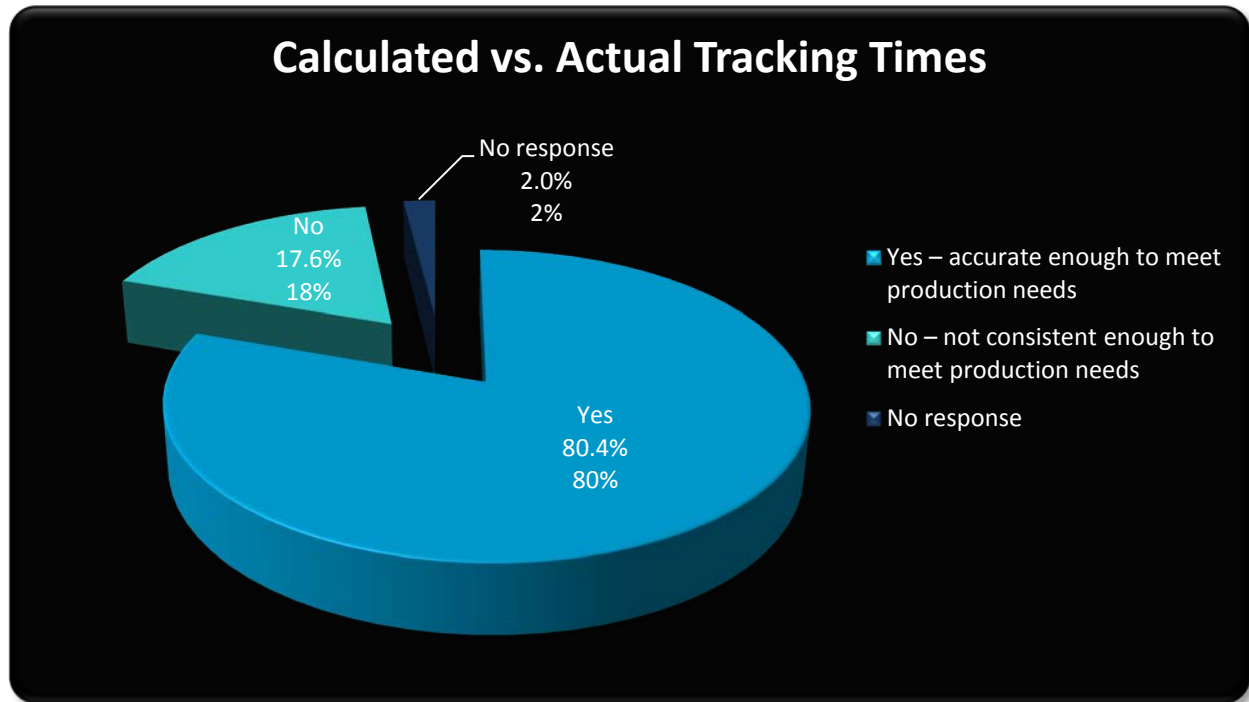
B - Additional Background and History

Progress in Industrial Ecology, an International Journal, Issue: Volume 3, Number 4 / 2006, Pages: 302 - 328 Henry Ford, Industrial Conservationist? Take-back, waste reduction and recycling at the Rouge Tom McCarthy A1 History Department, U.S. Naval Academy, 107 Maryland Avenue, Annapolis, MD 21402, USA

Abstract: Many of the ideas and practices of industrial ecology are not new. Nowhere is this more apparent than in the extensive waste reduction and recycling program implemented by Henry Ford and the Ford Motor Company at the famous River Rouge complex during the 1920s and 1930s. Perhaps the most noteworthy element of these programs was an automobile disassembly line for end-of-life vehicles. Ford's efforts occurred in the larger context of the USA's 'industrial conservation' movement, which

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the company epitomized while at the same time standing apart from it. Although Ford's program was widely publicized, the company's dominance, the idiosyncratic motive behind the program, and the arrival of the Great Depression, all worked against other companies emulating Ford's commitment.

C – System Comparisons – Case Study Notes/Diagrams/VSM/Gap Analysis

TPS 4 Rules (Spear, 1999)

- Rule 1: All work shall be highly specified as to content, sequence, timing, and outcome.

- Rule 2: Every customer-supplier connection must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses.

- Rule 3: The pathway for every product and service must be simple and direct.

- Rule 4: Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organization.

The Experiments of the Toyota Production System

When organizations are managed according to the four rules, individuals are repeatedly conducting experiments, testing in operation the hypotheses built into the designs of individual work activities, customer-supplier connections, pathways, and improvement efforts. The hypotheses, the way they are tested, and the response if they are refuted are summarized below.

Rule	Hypotheses	Signs of a problem	Responses
1	The person or machine can do the activity as specified.	The activity is not done as specified.	Determine the true skill level of the person or the true capability of the machine and train or modify as appropriate.
	If the activity is done as specified, the good or service will be defect free.	The outcome is defective.	Modify the design activity.
2	Customers' requests will be for goods and services in a specific mix and volume.	Responses don't keep pace with requests.	Determine the true mix and volume of demand and the true capability of the supplier; retrain, modify activities, or reassign customer-supplier pairs as appropriate.
	The supplier can respond to customers' requests.	The supplier is idle, waiting for requests.	
3	Every supplier that is connected to the flow path is required.	A person or machine is not actually needed.	Determine why the supplier was unnecessary, and redesign the flow path.
	Any supplier not connected to the flow path is not needed.	A nonspecified supplier provides an intermediate good or service.	Learn why the nonspecified supplier was actually required, and redesign the flow path.
4	A specific change in an activity, connection, or flow path will improve cost, quality, lead time, batch size, or safety by a specific amount.	The actual result is different from the expected result.	Learn how the activity was actually performed or the connection or flow path was actually operated. Determine the true effects of the change. Redesign the change.

Table 8: 4 Rules of the Toyota Production System

Define a CRM profile – Customer Resource Management

Larry Caretsky, President Commence 732-380-9100 www.commence.com/mfg/

• How clearly can customers articulate your value proposition?

• How well do customers know products or services?

• What is the customers preferred method of purchasing products and services supplied?

• Who do customers consider to be the preferred supplier products and services?

• When do customers typically purchase products and services?

• Why do customers typically purchase products and services?

• How do customers use products and services?

• Who is the decision maker? Who else influences the purchase?

• How do customers evaluate suppliers?

Definition of Sustainable Packaging - Sustainable Packaging Coalition

- Is beneficial, safe & healthy for individuals and communities throughout its life cycle;

- Meets market criteria for performance and cost;

- Is sourced, manufactured, transported, and recycled using renewable energy;

- Maximizes the use of renewable or recycled source materials;

- Are manufactured using clean production technologies and best practices;

- Is made from materials healthy in all probable end-of-life scenarios;

- Is physically designed to optimize materials and energy;

- Is effectively recovered and utilized in biological and/or industrial cradle to cradle cycles.

D - Case Studies

Value Stream Mapping – (www.lean.org) is used to establish the Identify the value stream, the set of all specific actions required to bring a specific product through the three critical management tasks of any business: the problem-solving task, the information management task, and the physical transformation task. Create a map of the Current State and the Future State of the value stream. Identify and categorize waste in the Current State, and eliminate it! Values Stream Mapping determines

- What - A visual tool for identifying all activities of the planning, and manufacturing process to identify waste.

- Why - Provides a tool to visualize what is otherwise usually invisible.

- Who - The leaders of each product family need to have a primary role in developing the maps for their own area.

- When - Develop a current-state map before improvements are made so that the efforts and benefits can be quantified.

- Where - On the shop floor, not from your office. You need the real information, not opinion or old data

Illustration 4: Value Stream Map for Toyota Motors, Indiana, (Cheng 2005)

Value Stream Map
Current State

Material Flow Icons

Assembly
Manufacturing Process

XYZ
Outside Sources

Warehouse
Warehouse

Cross Dock
Cross Dock

parts/ 1 day
Inventory

DAILY WINDOWS.
Truck Shipment

PUSH Arrow

Finished Goods to Customer

Supermarket

Physical Pull

"Go-See" Scheduling

General Icons

Uptime
Kaizen Lightning Burst

Operator

Buffer or

Information Flow Icons

C/T = 45 sec.
C/O = 30 min.
3 Shifts
2% Scrap
Data Box

Manual Information Flow

Electronic Information Flow

weekly schedule
Schedule

XOXO
Load Leveling

Withdrawal Kanban

Production Kanban

Signal Kanban

FIFO
First-In-First-Out Sequence Flow

Kanban Post

Sequenced-Pull Ball

Warehouse
DC #1

Ship Notification

Weekly Forecast
Daily report

1 suppliers
1 Truck / day

Cross Dock
DC #2

M Tu W Th F
Shipments

Return Container Management System

Production Control

Daily schedule (parts)

Ship Notification

52 week forecast (parts)

Weekly report

Empty Packaging

900 parts/day
189 packs/week

1 Weekly

Part Receipt	wip	Part Consumed	wip	Empty Staging	wip	Empty Pickup	wip	Truck → DC	wip
1 Cycle		54 Trays (A)		1 Trays		5 Pallets		3 Trays	
0.000		1095.000		300.000		360.000		330.000	
Takt = 10 min	2 totes	Takt = 1.2 min	2 totes	Takt = 1.2 min	12 totes	Takt = 1.2 min	7 totes	Takt = 1.2 min	3 totes
C/T = 0.00 min	167 min	C/T = 1314 min	1254.8 min	C/T = 360 min	310 min	C/T = 432 min	449 min	C/T = 396 min	440 min

Notes

	Trailer Load & Unload	Work time calculation (min)	
Takt 60 minutes/route	1.4 minutes/pallet	10 hour shift	600
18 Trips per shift	22 pallets/truck	lunch	-30
Lineside	30 minutes/truck	huddle	0
19 parts/tray	Daily Volume @ 900	first break	-15
18 trays/pallet	2 shifts/day	second break	-15
342 parts/stop (pallet)	54 trays/shift	third break	0
Transit Time Info	3 pallets/shift	cleanup	0
60 min/hr	108 trays/day	work time / shift	540
24 hrs/day	4 days/week	shifts	2
1440 min/day	432 trays/week	work minutes/day	1080
7 days/week			
##### min/week			

DC Inbound Empty
1 Cycle
0.141
Takt = 60 min
C/T = 8.5 min

DC Crossdock
189 Pieces

816 mins	418 mins	1374 mins	812 mins	606 mins	553 mins	Production Lead Time	76 Hrs
0 mins	1314 mins	360 mins	432 mins	396 mins		Processing Time	41.7 Hrs

Illustration 5: Value Stream Map for Internal Automotive Manufacturing Process – Distribution Center Shipments, Current State

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Value Stream Map
Future State

Plant: Production Plant
Process: All Containers
Name: Camille Chism

Material Flow Icons | **General Icons**

Assembly — Manufacturing Process
Kaizen Lightning Burst — Uptime
XYZ — Outside Sources
Operator
Warehouse — Warehouse
Buffer or
Cross Dock — Cross Dock
Information Flow Icons
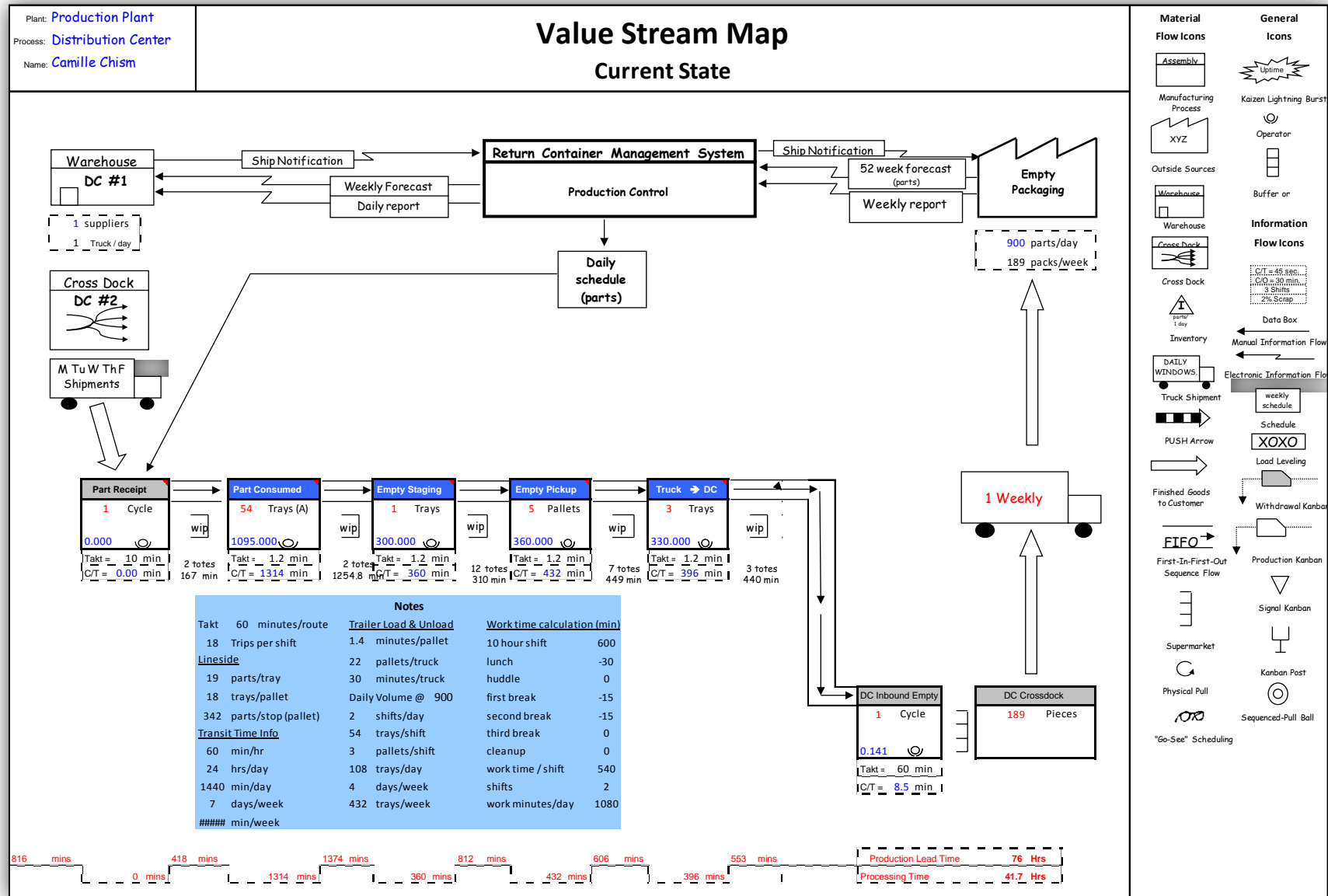C/T = 45 sec. / C/O = 30 min. / 3 Shifts / 2% Scrap — Data Box
Inventory — parts/1 day
Manual Information Flow
DAILY WINDOWS — Truck Shipment
weekly schedule — Electronic Information Flow
PUSH Arrow
XOXO — Schedule
Finished Goods to Customer
Load Leveling
FIFO — First-In-First-Out Sequence Flow
Withdrawal Kanban
Production Kanban
Supermarket
Signal Kanban
Physical Pull
Kanban Post
"Go-See" Scheduling
Sequenced-Pull Ball

Warehouse/ Supplier
Containers with Parts

Ship Notification

Return Container Management System
Production Control

Ship Notification
Daily report
(return packaging)

Empty Packaging

Weekly Forecast
Parts and Packaging

Cross Dock
AS needed

900 parts/day
189 packs/week

Daily schedule (parts)

JIT Shipments

Part Receipt	Part Consumed	Empty Staging	Empty Pickup	Truck → ILC
1 Cycle	54 Trays (A)	1 Trays	5 Pallets	3 Trays
0.000	1095.000	300.000	360.000	330.000
Takt = 10 min	Takt = 1.2 min	Takt = 1.2 min	Takt = 1.2 min	Takt = 1.2 min
C/T = 0.00 min	C/T = 1314 min	C/T = 360 min	C/T = 432 min	C/T = 396 min

wip — 2 totes 167 min
wip — 2 totes 1254.8 min
wip — 12 totes 310 min
wip — 7 totes 449 min
wip — 3 totes 440 min

Daily

DC Inbound Empty
1 Cycle
0.141
Takt = 60 min
C/T = 8.5 min

DC Crossdock
189 Pieces

Notes
Takt	60	minutes/route	Trailer Load & Unload		Work time calculation (min)	
	18	Trips per shift	1.4	minutes/pallet	10 hour shift	600
Lineside			22	pallets/truck	lunch	-30
	19	parts/tray	30	minutes/truck	huddle	0
	18	trays/pallet	Daily Volume @ 900		first break	-15
	342	parts/stop (pallet)	2	shifts/day	second break	-15
Transit Time Info			54	trays/shift	third break	0
	60	min/hr	3	pallets/shift	cleanup	0
	24	hrs/day	108	trays/day	work time / shift	540
	1440	min/day	4	days/week	shifts	2
	7	days/week	432	trays/week	work minutes/day	1080
	#####	min/week				

816 mins | 418 mins | 1374 mins | 812 mins | 606 mins | 553 mins
0 mins | 1314 mins | 360 mins | 432 mins | 396 mins

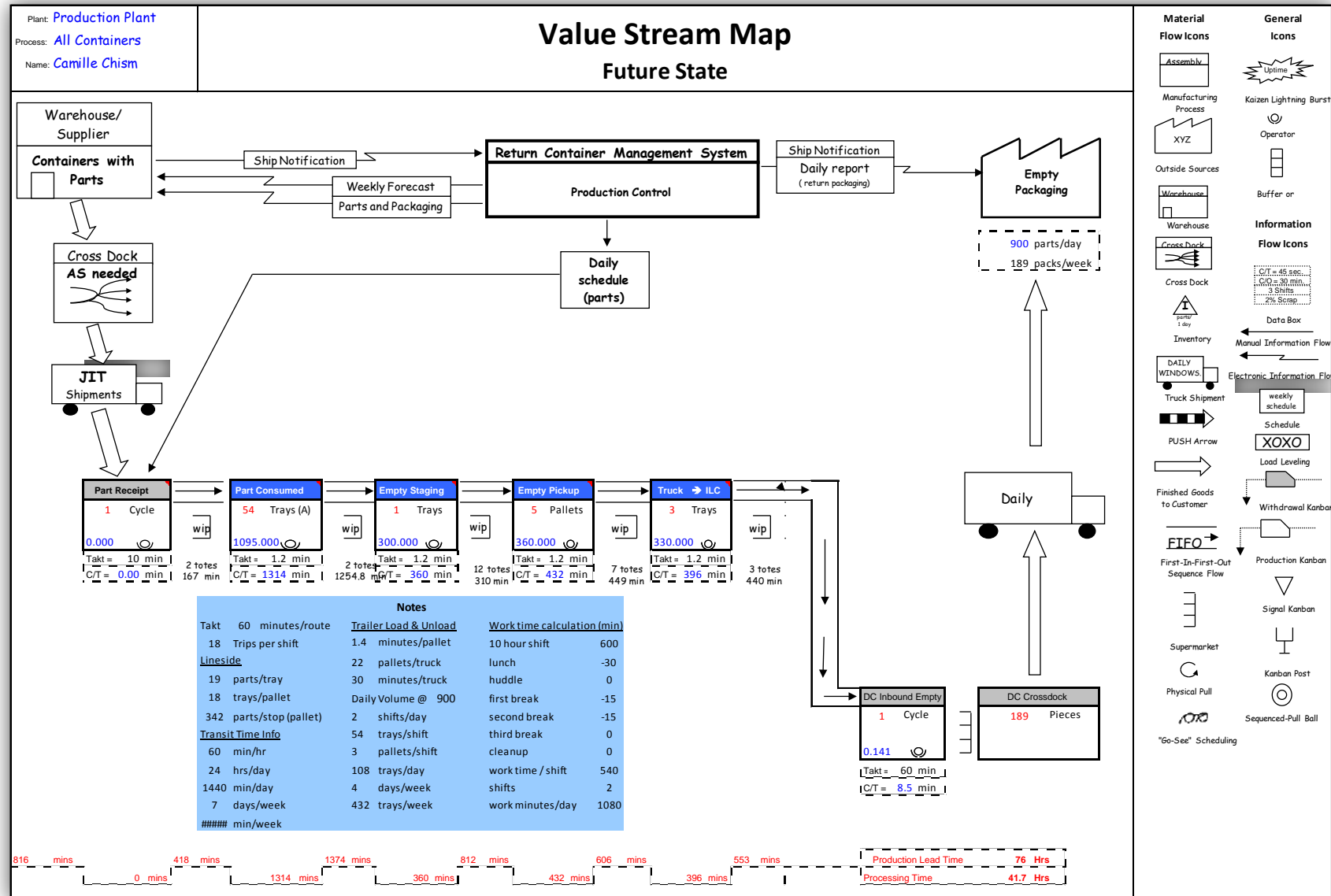Production Lead Time: 76 Hrs
Processing Time: 41.7 Hrs

Illustration 6: Value Stream Map for Internal Automotive Manufacturing Process – Distribution Center Shipments, Future State

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Table 9: Buckhorn, Inc. – Friendly & Affordable Brochure

Attribute of container	Corrugated one-way	Corrugated reusable	Fiberboard reusable	Reusable plastic	Used plastic reusable
Weight	1.5 lbs	2.2 lbs	5 lbs	5.5 lbs	5.5 lbs
Durability	Poor	Fair	Fair to good	Excellent	Excellent
Est. initial cost	$0.53	$1.06	$6.05	$11.03	$6.00
Est. life	1 trip	5 trips	50 trips	250 trips	250 trips
Cost/trip (avg.)	53 cents	21 cents	12 cents	4.4 cents	2.4 cents
Costs	Setup	Setup, return, setup again	Return	Return	Return
	Disposal	Breakdown	Repair		

E – Interview

Notes from meeting with S. Schmidt 4/21/2008, Container Management Supervisor

What are the top returnable items/issues faced in your Closed Loop Returnable System?

- Charges for expendable packaging (corrugated replacement packs) are charged back to the customer plants by suppliers. Cost of corrugated is excluded from product cost and considered a production related cost, charged directly to the plant. Additional recordkeeping is needed to track returnable packaging, expendable backup, and payment system for suppliers. Transportation costs are incurred when expedited orders are rush shipped to the customer or supplier site to meet production schedules.

- Distribution Center Requirements – several pieces of information are used to determine the requirements of returnable containers. The goal is compared to the actual fill & pooling (High Volume Domestic Assembly and High Volume NAFTA Assembly Locations greatest challenges)

- Direct Routes recordkeeping issues and volume fluctuations can lead to the need to expedite returnable containers

- Plant Yards - Outbound Management notification needs to be followed up with
Stockpiling

    - Distribution Center Load Pickups – trucks are loaded at the distribution center cross dock operation and the carrier is called for pickup. The time that pickup occurs varies, due to schedules, routes, driver hours, etc. The load may be picked up immediately or sit in the yard for days.

- Trailers remaining in yard show in tracking system as in transit. The extended transit time due to the pickup delay is not accounted for. If the load sits long enough to cause the delivery to expire (e.g. if the calculated transit time is nine (9) days, but a driver runs out of hours or a loaded trailer sits on the yard for 2 extra days), the transit time in the system will essentially expire. The load drops out of the tracking queue; the system recalculates, and triggers a need for additional container shipments. This new requirement shows as a shortage for the supplier and

- Inventory Levels (parts are shipped in containers, inventory levels of parts drive container orders and inventory levels of containers are expected to follow the pattern of part inventory levels)

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