A Better way to Track Inventory
Use License-Plate-Number Container Tracking Barcodes

Using the FedEx on-line tracking service you can track a box of parts from the factory in Shenzhen province in China, through Hong-Kong, and the FedEx hub in Memphis, onto the local delivery truck, and then be notified when it is delivered to your plant, in real-time.

So why can't you find that box of parts now that it is in your plant or warehouse?

The answer is probably because you are still tracking your inventory by location rather than using license-plate-number (LPN) container tracking methods like FedEx, UPS, and DHL.

In this white paper we explore how to dramatically improve the accuracy and timeliness of your inventory tracking by using license-plate container tracking as well as to achieve materials traceability and accurate job costing.

Tracking Inventory the Old Way

The classic accounting or ERP (Enterprise Resource Planning) method of tracking inventory is to track the quantity of material at a location in an inventory table within a database. The location may be as big as a warehouse or as small as a shelf. This may be supported by subsidiary tables listing the lot numbers and serial numbers of parts at a location.

The big disadvantage is that every time I move materials, I have to withdraw materials from the original location in my inventory tracking system and enter them into the destination location. If I use small locations, such as shelves, I have to do a withdraw transaction from one location of the parts that I want to move and then an enter transaction of those parts into another location.

With many small locations, this requires many transactions to be entered into the ERP system every time I move materials around the warehouse, especially if I am doing lot and serial number tracking. This data entry can be very time consuming and error prone. For this reason many companies use large locations in their ERP systems, such as entire warehouses.

Contrast this with the ease and accuracy of recording the movement of a FedEx package where the movement of the package is recorded at each location by scanning the barcode on the package, no matter how complex the contents of the package, which may be a shipping container with many different parts with many different lot numbers and serial numbers inside the container.

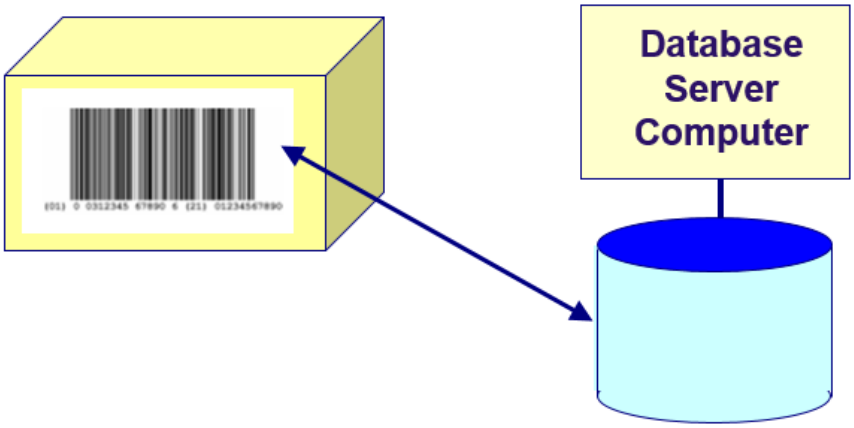
The big benefit of license-plate-number tracking is that the data about what is in the package gets entered once, at the point of receipt, and thereafter recording the movement of the container is simply a matter of scanning the barcode on the package at every location as it is moved.

License-Plate-Number Container Tracking

The concept behind license-plate-number tracking is that a unique tracking barcode is applied to each container and then all the information about the container is stored in a database, where it can quickly be accessed. Also data about that container, such as its location and the quantity in the container, can quickly be changed by scanning the tracking barcode on the container.

License-plate-number container tracking gets its name from what happens at the registry of motor vehicles when you go there to register a new car or truck. They hand you a license plate with a unique set of letters and numbers and the state of issue marked on the plate. The license plate number is unique but otherwise is just a random set of letters and numbers. All the data about your car or truck is stored in a database so that, when you get pulled over for speeding, the police officer simply reaches over to his on-board computer and types in your license plate number and is able to see all the information about your car or truck.

We use a similar principal for license-plate-number tracking of materials except that we put a unique tracking barcode or RFID tag on each container instead of an aluminum license plate.



Note this is very different from using barcodes with data such as item number, quantity, and lot number on each container. With license-plate tracking all the data is kept in a database and the tracking barcode is simply a reference to the database record.

For containers such as boxes and pallets, which are discarded when they are empty, we typically print and apply a license-plate tracking barcode to the container of materials when it is first entered into inventory. For reusable containers, such as totes or bins, we can use permanent metal barcodes, as we do not have to change the license plate just because we changed the contents of a container (analogous to the license-plate-number on a car or truck).

The benefit of this is that data such as part number, location, quality control status, and quantity of materials in the container can be changed as needed without replacing the tracking barcode on the container.

License-plate-number tracking is a GS1 (Global Supply Chain 1) standard, where GS1 standard barcodes are used for Serialized Shipping Container Code (SSCC) barcodes which uniquely identify the containers to which they are attached on a world-wide basis. This enables a shipper to record what materials were placed in on a pallet in China and send the information related to a warehouse in the USA in the form of an ASN (Advanced Shipment Notice). When the materials are received in the USA all that is necessary is to scan the SSCC license-plate barcode to receive the materials without first breaking down the pallet.

The license-plate-number tracking barcode may be as complex as a GS1 composite barcode, printed on-demand, with a GTIN, Lot Number, and Serial number, for use in the Global supply chain, or as simple as a barcode taken from a pre-printed roll of serialized barcodes, such as that shown here, for internal use within the plant. The license-plate-number tracking barcode label may also contain an RFID chip with the same tracking number or a separate ruggedized RFID tag may be used depending on the application.

As well as being placed on containers, LPN tracking barcodes are placed on items that are not in containers. Examples include large electric motors and other electro-mechanical assemblies which may need to be tracked independent of being in an external container. These individually barcoded items may also have serial numbers which may be used as their tracking barcodes or the serial numbers may be different.

Some types of container are obvious, such as boxes, pallets, and totes. Others are not so obvious, such as reels and rolls, which contain a quantity of an item. These can be treated as a container with so many feet, for example, of material, or as individually barcoded items where dimensions such as length, width, and thickness may be treated as attributes of the individually barcoded item.

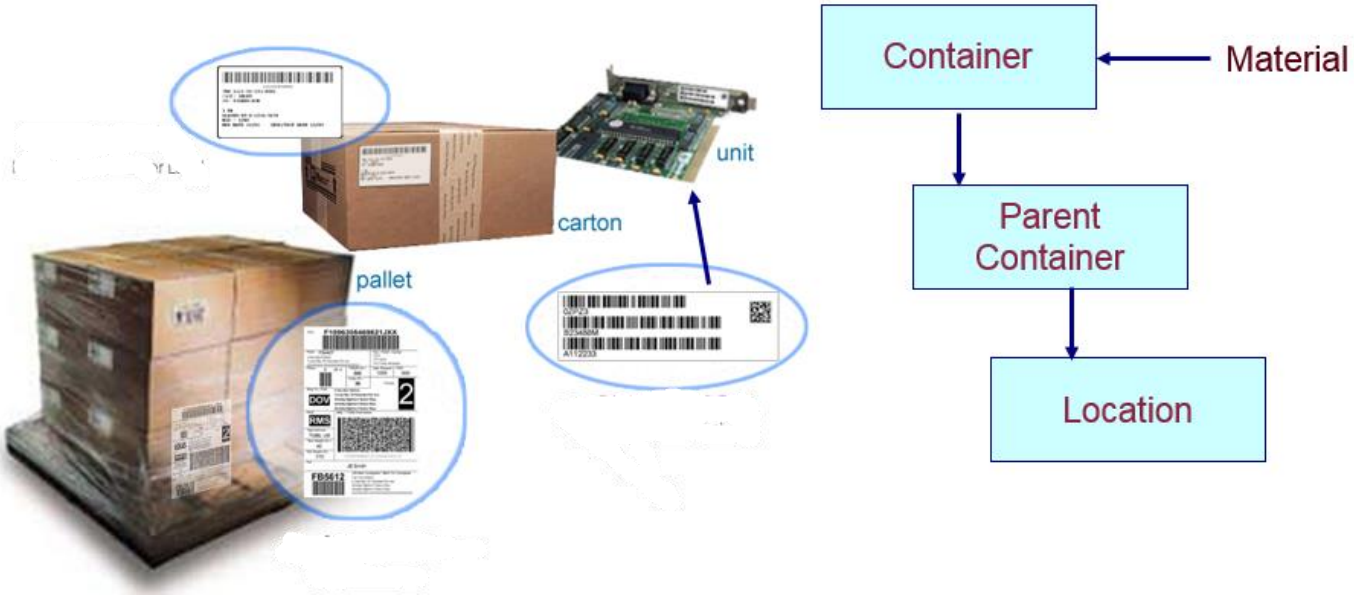
The big difference from traditional inventory tracking is that when we want to know how much inventory we have in stock, we add up the quantity of all like materials in all the containers wherever they are located, even if they are being moved from one place to another.

Because recording a change in location is as easy as scanning the tracking barcode on the container and a location barcode on a shelf or rack where we put it, we can use much finer grained locations for tracking. This enables us to know that our box of parts is on shelf A-10-6 rather than just somewhere in the warehouse.

It also makes "inventory taking" much easier in that you do not have to shut down your operations to count the inventory in the whole of your warehouse but only have to validate that the containers of material on a shelf match those those in your tracking system, one shelf at a time. As a result you can do inventory validation incrementally without shutting down or disrupting operations, in order to take inventory.

This encourages checking inventory frequently rather than waiting for a once-a-year inventory taking to discover your inventory discrepancies.

Nested Container Tracking



One of the problems that is very hard for traditional inventory tracking systems to handle is how to track nested containers. In a nested container situation, such as the above example, we may have parts with serial numbers in cartons, with cartons containing many different part numbers stacked on a pallet, with multiple such pallets at an inventory location.

In a traditional ERP inventory tracking scheme, when you move a pallet to new location you have to record the withdrawal of all the parts from the old location and enter them into the new location.

With a system such as BellHawk, which does nested license-plate tracking it tracks materials, which may have their own license-plate tracking barcode, in containers, which will have their own tracking barcodes, and may have a tree of parent containers, each with their own tracking barcodes, that are at a location.

Then, when you want to record the movement of the container, you simply scan the barcode on outer parent container (in this case the pallet) and record its new location. All the data about all the materials on the pallet is automatically associated with the new location.

The same goes for shipping the parent container, when all the materials in the parent container can be recorded as having been shipped to the customer simply by scanning the tracking barcode on the outer container.

Even better, the nested container data, which a system like BellHawk tracks, forms the basis of Advanced Shipment Notice (ASN) data, that can be sent by EDI (Electronic Data Interchange) to your customer so that all your customer has to do is to scan the tracking barcode on the shipping container, such as the pallet, and associate it with the ASN to receive all the materials into their inventory, with no additional data entry.

Similarly, systems like BellHawk can also use ASN data to minimize the work needed to record the receipt of materials from your suppliers.

Minimizing Inventory Errors

There is nothing worse than:

- Going to pick the parts for a customer order and finding that there are not enough parts in the bin.
- Going to pull the parts for a production run and finding that there are not enough parts in stock.
- Getting part way through a production run and finding that you do not have enough materials to complete the run.
- Sending a team out to do an on-site installation only to find out that they do not have enough parts to complete the installation.

These are all problems that arise because of discrepancies between the quantities of material recorded in the inventory tracking system do not correspond to those that are physically in stock. When they occur, the cost of handling these problems typically exceeds the cost of the missing parts by orders of magnitude.

A common solution to this problem is to carry "safety stock" for each part. This conflicts with Lean and demand-based inventory management concepts, where we want to just carry enough inventory to meet projected demand. The problems with this approach are also apparent when you wander round many stock rooms and find dust-covered boxes of "safety-stock" inventory left over from products that are no longer made or offered for sale.

The ways that license-plate-number container tracking minimizes these problems include:

1. By capturing data about containers of material once, when they are received or produced, and then not having to re-enter the data. As the containers of material are received or produced based on purchase orders or work orders then data entry is minimized and, as a result, errors are minimized.
2. By tracking when containers go empty. A system like BellHawk will track the quantity of material remaining in a container, as parts are picked or withdrawn from the container. But quantities of material in a container may be inaccurate, due to reasons such as:
    a. A 10lb box which nominally contains 1,000 washers may, in reality contain between 990 and 1,010 washers due to weight variability of each washer.
    b. A can of paint may still contain some unused paint on the walls of the can when it is discarded as empty.
    c. Errors in recording incremental quantities withdrawn from the container.

    The tracking system may show that a box contains 4 washers when it goes empty. By marking that container as empty, these 4 washers are no longer included in the inventory

count. This enables incremental correction of inventory as each container is consumed, which is much better that waiting until all hundred boxes of washers or cans of paint are consumed to find a major shortage in inventory.

3. By weighing containers to check quantities. One great way of checking inventory is to periodically weigh all open containers. This can be done when materials are withdrawn or returned to stock or just as part of "cycle counting". A system like BellHawk can track the estimated tare weight of each container and so the container can be easily weighed to estimate the number of washers in a box, the quantity of paint in a can, or the amount of material on a roll.

4. By preventing picking errors. A common problem is that the pick sheet for a production run or for a customer order requires one part but the picker picks the another part. Besides causing problems with production or order shipments, this can be a major source of inventory error. With a container tracking system like BellHawk, the barcode on the container from which parts are withdrawn is scanned and the picker is warned if they are picking the wrong materials.

5. By avoiding delays in updating inventory. By recording receipts, movements, usage, production, and shipping of containers of material in real-time using barcode scanning, the inventory of containers is always up to date.

   Contrast this with traditional inventory tracking methods where inventory withdrawals from materials at locations are typically written on paper forms by production staff and then keyed into an ERP or accounting system one or more days later. These errors in updating inventory can then result in delays in ordering or producing needed materials, especially if supply chain management is based on the use of classic Materials Requirements Planning methods, such as are incorporated in most ERP systems.

6. By avoiding the evils of "backflushing". Many companies, to avoid large amounts of data entry relative to inventory withdrawals, reduce the quantity of raw materials in stock based on the BOMs (bills of materials) for their products when they ship them to customers. This can result in huge inaccuracies in inventory counts due to delays in recording inventory withdrawals and also due to failing to take account of scrap and wastage in the production process.

With a container tracking system like BellHawk, the reduction in inventory is recorded as soon as the materials are scanned in to an operation on a work order or are automatically recorded as being used from floor stock as soon as each container of work-in-process materials are scanned out the work order operation. Also scrap and wastage is recorded in real-time using barcode scanning.

Handling Off-Cuts

Any company that handles dimensioned materials faces the issue of how to track off-cuts. These may be in the form of:

- "Butt-rolls" returned to stock after consuming part of the materials on a roll of material.
- Left over partial sheets of plywood or steel from production processes
- Left over lengths of metal or wood

Many companies create a part number, such as for a 100' long roll of material 36" wide, or a sheet of 4'x8' plywood, or a 6' length of steel rod. They receive these and record their inventory in terms of these descriptions and record whole units being withdrawn from stock. They then totally ignore returned to stock of the remaining material.

This has two major problems:

1. There is not tracking of offcuts - so they cannot be effectively reused or accounted-for in inventory valuation.
2. Typically offcuts are reused on an ad-hoc basis by production workers on jobs without this being recorded. This can result in major errors in job costing as whole units are charged to one job and then no materials are charged to another job as offcuts are used.

A container tracking system like BellHawk can track the length and width of each barcoded "container" whether this is a left over roll of material, a partial sheet of plywood returned to stock, or a partial length of a steel bar.

Each of these typically has one part number in the accounting system, irrespective of dimensions of the material, and a per square or length unit of value in a system such as BellHawk. Thus, when we receive a 4'x8' sheet of ½" ply, we can compute the unit value based on the purchase price.

If we use 6' of this sheet on a job, we can compute the value of the plywood used on the job and we can track and accurately value the 2'x4' offcut returned to stock. Then, when this off-cut is used on another job, we can accurately assign the material cost.

Also, when we want to determine the value of all the ½" plywood we have in stock then a system like BellHawk can add up the value of all the sheets of ply in stock, including off-cuts, and report these on a nightly basis to the accounting system.

Valuing Inventory

Traditional location based inventory tracking systems use all sorts of artifices to value inventory, such as assuming that materials are used in a FIFO order (which frequently does not happens in practice), based on price tranches in effect when the materials were purchased. Others use standard costs, which are based on the average purchase or manufacturing costs over the past

year, adjusted, if needed, by reading of chicken entrails or other black-magic accounting methods to allow for changes in market conditions.

A system like BellHawk tracks the quantity of materials in each container along with a unit cost. For purchased material, this is the unit cost for each container at time of purchase. For manufactured products, it is typically the cost of the materials, labor, and machine time that were used in making each container of materials, at the time they were made.

Is it correct to simply add-up the value of all the containers of material tracked by BellHawk to get the inventory value? The answer is that it depends.

For a make-to-order operation that primarily purchases materials for each job or with a short lead time then this can be very accurate. But for operations that carry a large stock of certain materials, such as gold, copper, or steel, as a hedge against supply chain issues, then this may not be an accurate estimate of the inventory value.

For such materials, it is typically better to use the current market value per ounce or pound at the end of each month, then add up the weight in all the containers at that time, and transfer the resultant value to the accounting system for inclusion in the balance sheet.

With a system like BellHawk that does container tracking, it does not have to be all or nothing. Some types of material can be treated one way and other types of material treated another way depending what is best for the specific business (and on what financial results are desired). Thus containers of raw materials can be valued at actual cost but containers of finished goods may be valued based on the expected sales price.

Materials Traceability

The use of license-plate-number materials tracking is especially important if an organization needs to track which materials went into which products in order to be able to track the source of defects and to minimize recalls in the event of defects. It is essential if an organization is in market verticals such as food or pharmaceutical processing or biotechnology. It is also important for organizations such as those in the automotive and medical device industries whose products impact health and human safety.

With container tracking system like BellHawk, the system is able to track:

1. The source of each container of raw materials or ingredients, including data such as lot and serial numbers, certifications, material properties and, in the case of food, data such the farmer's field where it was grown or where the seafood was harvested.
2. The quality control status of each container. Does it need inspection, has it passed inspection, or has it failed and why? This data can be used to prevent the usage of the material in the container.
3. Which containers of materials are used to make containers of intermediate and finished products and which containers of finished product were shipped to each customer?

This gives a system like BellHawk the information it needs to trace back from a defective finished product to all the materials that went into it, through multiple levels of intermediate product. It also gives a system like BellHawk the ability to start with knowledge of a defective container of raw or intermediate materials and to determine all the containers of finished product that may be effected.

Project Control

One of the major problems faced by many Government, construction, and engineering contractors is that they purchase inventory for use on multiple projects. Often these materials are billed to customers before they are used on customer projects or shipped to a customer site.

In such situations, it is very bad practice to have a bin of 1,000 parts of which 300 are for one project, 200 for a second, and 500 for company owned common stock. It is potentially criminal to use parts owned by one customer on another customer's project.

It is very hard to keep these materials apart using conventional location based inventory tracking. A container tracking system like BellHawk tracks which projects and customers each container is for and belongs to. In this way a system like BellHawk can prevent the usage of parts owned by one customer or designated for a specific project on another project for another customer.

This designation of containers as belonging to specific customers and projects can also prevent reporting customer owned inventory as part of the company's assets, which is a violation of many accounting regulations.

Commentary

Some questions that I frequently get asked are

1. **"Should my organization be using License-Plate Container Tracking Methods?"** The answer is, it depends.

   If you are importing a limited quantity of specialized Italian shoes to sell from your basement through your website, then you do not need the complexity of a container tracking system like BellHawk. All you need is a simple check-in, check-out inventory tracking system.

   But if you do manufacturing, major construction, engineering, food or pharmaceutical processing, or are in biotechnology then you probably should be using license-plate container tracking.

2. **"Why can't I use my ERP and accounting system to do license-plate tracking?"**

   The answer is that a license-plate number tracking system needs to use a "Containers" table in its database, which tracks material in nested containers, rather than tracking inventory at a location.

ERP and accounting systems are built around the needs of tracking and computing the value of inventory for financial record keeping rather than for real-time operational tracking and hence track inventory at a location.

3. **"How can I use container tracking with my existing accounting or ERP system?"**

   The answer is to use a container tracking system such as BellHawk in combination with an automated data exchange platform such as MilramX (www.MilramX.com) which uses AI based rules to translate between the historical "inventory at location" financial model of ERP and accounting systems and the dynamic real-time container tracking model that a system such as BellHawk uses for operational tracking.

4. **"We are a distributor, should we be using license-plate container tracking to replace our WMS (Warehouse Management System)?"**

   If you simply do boxes/pallets-in, boxes/pallets-out distribution, then the answer is no. But if you do secondary operations such kitting, repacking, relabeling, or light assembly and need materials traceability then you do. Also if, as a result of the repack and relabel operations, you need to send ASNs by EDI, then you should probably be using license-plate container tracking.

Author

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