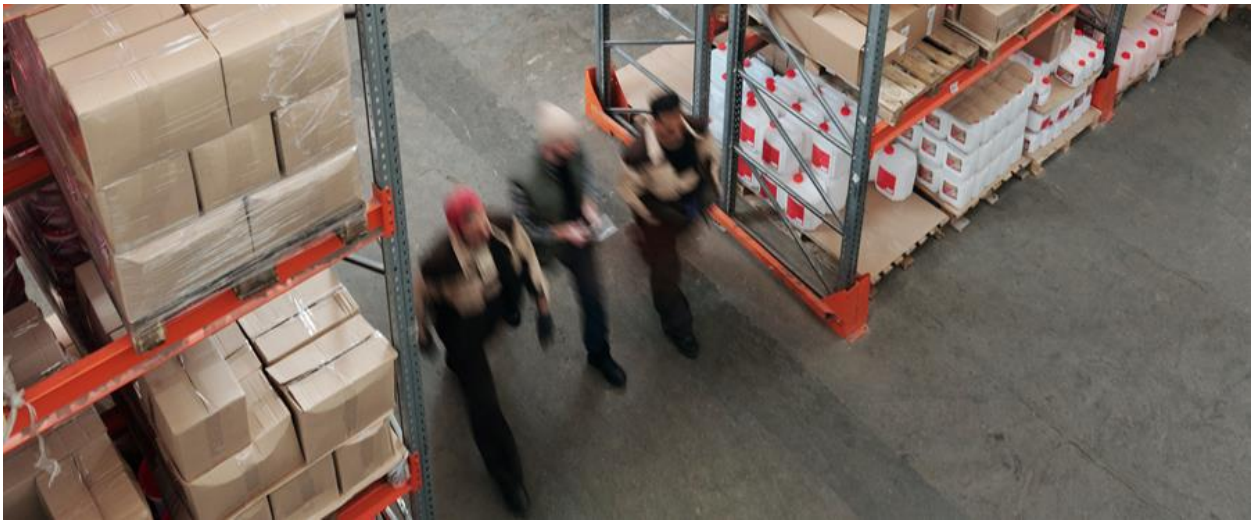
Where is My Box of Parts?

A White Paper
By Dr. Peter Green



Introduction

A client ordered a box of parts to be air-freighted from the manufacturer in Shenzhen province in China and then used the tracking number to watch its progress from the FedEx Shanghai hub, through Hong-Kong, through FedEx's Memphis distribution center, to the local distribution hub, to delivery to their receiving dock. And then "Poof" it disappeared like magic and no one seems to be able to find it.

On another occasion, I personally witnessed a material handler walking up and down the aisles looking for a box of special bottle caps needed for a production run for a customer order. Their ERP system said they had enough in stock for the production run but when the material handler went to withdraw the parts from their regular location, they were nowhere to be seen.

Soon the material handler was joined by the lead warehouse person, who was joined by the warehouse manager, and then by the materials manager, summoned from the front office. Before long, there were the four of them walking up and down the aisles for the better part of an hour. But the bottle caps were nowhere to be seen. As a result, the manufacturing order had to be cancelled and delivery to the customer postponed until new bottle caps could be ordered. This resulted in an unhappy customer who never ordered again.

Eventually, when we put a container-based tracking system into the warehouse, we found the box of bottle caps. Apparently, there was not enough room in the designated location for this box, when it had been received, and so the materials handler had put it on a spare rack at the back of the warehouse. He even put a sticky note on the main rack location to this effect. But that quickly got lost amongst the hustle and bustle of a busy warehouse.

In a third case, a manufacturer of curtain-wall windows for office buildings frequently got calls from their installers to say they were missing a part for one of the windows. They then had to make a new part and express ship it overnight to the construction site, at significant expense.

In this White Paper we examine what went wrong in these situations and how supplementing the organization's ERP system with a real-time container-based tracking system could have avoided these problems.

What Went Wrong?

In the first case, it turned out that an engineer working on the project stopped by the receiving dock and picked up the parts, as he knew they were critically needed for his project being assembled on the production floor. The receiving person filled out the paper work to indicate that the box of parts had been received, and even made a note that the engineer had picked it up, before forwarding the paperwork to the font office for entry into their ERP system.

The person in the front office entered the receipt into their ERP system simply by ticking off the parts as having been correctly receiving against the purchase order. As a result, the note about the Engineer picking up the parts got consigned to the filing cabinet along with all the other purchase order documents.

The parts were never recorded as having been put way in the warehouse, in the company's Warehouse Management System (WMS) because they were never put away and, anyway the WMS had no way of recording or tracking the issuance of parts to people.

This situation was fortunately resolved the next day at the daily production planning meeting but could have been much worse if the Engineer had got busy and forgot to deliver the parts to the factory floor.

In the next case, the problem stemmed from the fact that they had no way of tracking the location of different containers of materials. They simply used standard locations for each part and assumed that all parts with the same part number were in the default location for that part. Ideally, they would not order more parts than they had space for. The actual quantity stored was, however, dictated by their customer who, in this case, needed an extra-large quantity. As most parts came by the pallet, pallets with excess parts were simply dropped on the floor in the vicinity of each part's default location and boxes of parts often got placed wherever there was room, sometimes in overflow locations at the back of the warehouse.

Needless to say, this was not ideal, with some aisles cluttered with pallets while other parts of the warehouse were empty as there was no current demand for the parts which were supposed to be in those locations.

In the third example, it turned out that they had accurately shipped whatever was supposed to be part of a delivery but then a part got lost or misappropriated once at the building site. In one case, they found a critical window frame part had been sawn down to make a prop for a staging the carpenters were installing.

Unfortunately, in most cases, the manufacturer had to eat the cost of replacing a missing part as they had no proof it was shipped because they were not tracking what was packed on each pallet or that the pallet had been loaded onto the delivery truck.

Technology Shortcomings

In each of these cases, the companies were using an ERP system in combination with an Inventory Tracking or Warehouse Management System (WMS) system. So why did these not solve the problems?

Most ERP, Inventory Tracking, and WMS systems are item locator systems. That is, in their databases, they track the quantity of each part at each location. These might be supplemented by subsidiary tables listing parts by lot number or even serial number. Accounting systems, such as a base QuickBooks system, simply track the total quantity of parts in stock without regard to location.

Item locator systems, such as Warehouse Management and Inventory Tracking Systems, are simple to use, unless you want to track lot numbers and serial numbers, and are preferred for simple inventory tracking applications.

Some use barcode scanning to ease the recording of parts movement by scanning the part number on the rack or bin location for that specific part, followed by a location barcode on the rack or shelf, and then recording the quantity entered, moved, or withdrawn. In the case of Warehouse Management Systems this information is then relayed to an ERP system.

Item locator systems, however, cannot:

1. Track individual containers of material or serialized items by location or by the person they were issued to.
2. Track assets and inventory in the same system, using a mix of barcode and RFID scanning.
3. Track the movement or shipping of nested containers of materials, such as pallets with many parts on them.
4. Track the characteristics of an individual container, such as the length of wire on a reel, the PH of chemicals in a drum, or the hardness of a bar of steel.
5. Track the quality control status (needs, passed, failed inspection) of each container of material or serialized item to make sure that only good materials are used or shipped.
6. Prevent operational mistakes such as using or picking the wrong materials for a job or customer order.
7. Capture materials traceability history, recording which materials, by lot, serial number, and other characteristics, were used to make each batch of product or went into each kit.

8. Capture the actual cost of materials used for each job rather than using average costs based on some FIFO formula.
9. Track parts purchased for each project or owned by customers separately from each other and keep them from being comingled or used on the wrong project.
10. Give accurate value of inventory based on actual purchased cost, plus manufacturing cost, or based on market spot value.

The other big disadvantage of item locator systems is that, if I have a box of parts with different lot number and serial numbers in it, and move it from one shelf to another in the warehouse, I have to separately record the movement of each part to a new location. This also applies to pallets with multiple parts on them.

For this reason, many organizations simply treat each warehouse as a single location, to avoid recording the movement of materials from one location to another. This works well from an accounting viewpoint, where all we need to know is the quantity in stock, but is not very useful for locating parts in the warehouse.

Container Based Tracking

All the issues described above are solved by the use of container-based tracking.

In container-based tracking we place a tracking barcode on each container or serialized item we wish to track. We then scan the tracking barcode and record the new location every time the container is moved or materials are added or withdrawn from the container, or the container or serialized item is issued to a person or returned by a person. This is directly analogous to the tracking method used by organizations such as Amazon, FedEx, and UPS.

This method is sometimes also called “License-Plate-Number” (LPN) tracking because of its similarity to how cars and trucks are tracked by their number plates. The license plate simply contains a unique set of letter and numbers which have no relationship to the car or its driver or passengers.

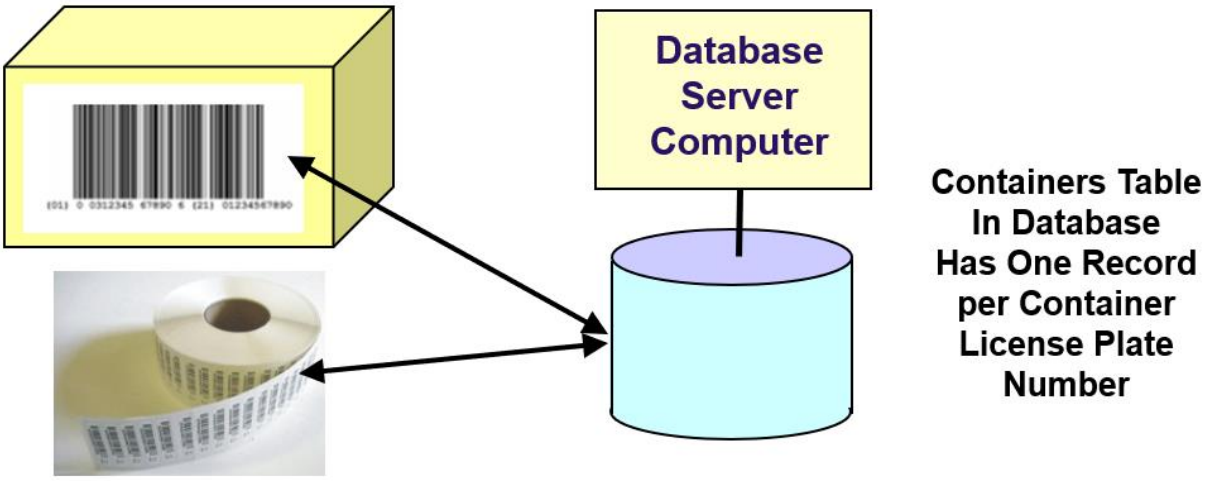
This is analogous to the tracking number used by Amazon, FedEx, UPS and the USPS.

This method is now the standard for tracking materials in the global supply chain and is the basis for the GS1 standard which governs the contents of tracking barcodes and RFID tags to make sure they are unique

Just like in a Warehouse Management System or inventory tracking system, we scan location barcodes on racks or shelves to indicate the location where the material is being moved to.

But in container-based tracking, we scan the tracking barcode on the container and not a barcode containing a part number to record the movement of materials.

When we first enter a container of materials into inventory, in a container-tracking system, we record the part number and quantity of material in that container, as well as the lot number, serial number an expiration date, if applicable, as well as the unit cost, and any user defined parameters. These are all associated with the tracking barcode through a Containers Table in the tracking system database.



The tracking barcode refers to an entry in the Containers Table where all the data about the contents of that container are stored. The benefit of this is that the data about the contents of the

container only has to be entered once and not every time the container is moved, as in an item locator warehouse or inventory management system. This enables detailed tracking of the location of each container, along with all the data that relates to the content of each container.

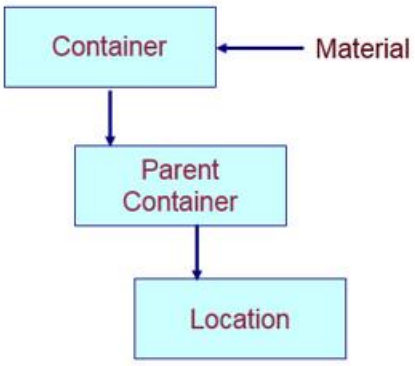
In a system like BellHawk, the tracking barcode can be a GS1 standard barcode, as shown at top, in the above diagram, or a simple serialized barcode peeled off a pre-printed roll and attached to each container as it is entered into inventory, as shown at bottom.

This tracking barcode can also be printed on-demand with human readable information and, if needed, other customer specified barcodes, using a barcode label printer and can contain an RFID chip, which refers to the same container in the database.

This enables a mix of barcode scanning and RFID tracking to be used. For example, this enables the use of barcode scanning where precision of location is required for recording raw materials inventory combined with using RFID to automatically record the movement of products from one production operation to another in one system.

A container-based tracking system like BellHawk can also be used for tracking assets by placing the tracking barcode directly onto the item. This enables BellHawk to track the issuance of assets and containers of material to people, as well as to locations.

Container-based tracking also enables the tracking of nested containers, such as pallets containing many different materials.



Here we can record individually tracked items and/or loose material into a box and then apply a tracking barcode to the box. Boxes can then be scanned as they are stacked on a pallet, which gets is own tracking barcode.

To record the movement of the container, all that is needed is to scan the tracking barcode on the pallet followed by scanning the location barcode, such as on a marker post indicating an area of the warehouse floor. This is opposed to what you would have to do in an item locator system, where you would have to individually record the movement of each part to the new location.

Similarly, the tracking barcode on the pallet can be scanned to record the shipping of the pallet or the loading of the pallet onto a truck or its trailer. Again, only a single scan is needed as opposed to recording the shipment of each part on the pallet.

A system like BellHawk keeps track of all the nested containers and materials on each pallet, such that if a box is removed or a part is removed from a box, BellHawk tracks what remains on each pallet. Also, when a set of pallets is shipped the data is available to send an Advanced Shipment Notice (ASN) to customers and/or their distribution warehouses.

One major difference with item locator systems is the ability of BellHawk to track the lengths of wire on each reel or the length and width of each roll of material. An item locator system, for example, can record the receipt of ten 500-foot reels of wire and the withdrawal of each reel from stock. But when a reel is returned to stock with 200 feet of wire, an item locator system cannot record this, as all it knows about is whole reels, whereas a system like BellHawk can record the length on each individually tracked reel.

Another major advantage of a container-tracking system, like BellHawk, is that it can use "Dynamic Binning" placing parts wherever there is room in the stock room or warehouse and allowing BellHawk to track where parts were placed. This is in contrast to item locator systems which designate a warehouse location for each different part. The result is often a 50% savings in the size of warehouse space needed to accommodate fluctuating demand for different parts. This is especially true for project-based organizations where each project requires a different set of parts.

BellHawk tracks each container of parts as to which project and customer they belong to and can prohibit the mixing of like parts from different projects or belonging to different customers. It also warns materials handler if they attempt to use parts purchased for one project on another or to use parts belonging to another customer.

This is not to preclude the use of recommended locations for specific parts, or projects, or customers but allows material handlers to use overflow space when needed and to record exactly where the parts were placed.

Advantages and Disadvantages of Container Based Tracking

For simple stock-room tracking situations, where all that is needed is to track the quantity of each part in stock, then item-locator systems are simpler to setup and use. But where the application requires tracking the characteristics of parts in each individual container or of each asset then it is essential to use container-based tracking.

An advantage of item locator systems is that their compatibility with accounting and ERP systems which track the quantity of each part at each location for accounting purposes.

With a container-based tracking system we have to use a piece of software, such as KnarrTek's MilramX information exchange software to translate between:

1. The receipt of containers of materials and Purchase Order line item and accounts payable receipts in an accounting system.
2. Consumption and production of containers of material to make products and changes to inventory quantities in the accounting system.
3. Shipment of containers of material and corresponding Customer Order line items and accounts receivable recording, as well as changes to inventory quantities in the accounting system.

With MilramX these updates happen automatically but the data transfer objects still have to be scripted for each different accounting or ERP system, which adds to the cost of systems implementation.

In summary: if you need to track individual containers of material or assets then you need a container-based tracking system such as BellHawk. If not, then you are probably better off with a simpler item locator system such as an Inventory Tracking System or a Warehouse Management System. And, if your application is really simple then you may be able to use the materials tracking capabilities built into your ERP or accounting system.

Author

This white paper was written by Dr. Peter Green, who serves as the Technical Director of KnarrTek Inc. Dr Green obtained his BSC (Hons) in Electrical Engineering and his Ph.D. Degrees in Electronics and Computer Science from Leeds University in England. Subsequently Dr. Green was a senior member of technical staff at Massachusetts Institute of Technology and a Professor of Computer Engineering at Worcester Polytechnic Institute.

Dr Green is a Systems Architect who is an expert in using real-time artificial intelligence methods to implement real-time Inventory Tracking and Operations Management systems for Industrial Organizations. He has led the implementation of over 100 such systems over the past decade. Dr Green also led the team which developed the BellHawk job and materials tracking software and MilramX intelligent information integration software platform.

For further discussion, or to send comments, please contact peter.green@KnarrTek.com.

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