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Understanding Errors

"What does it take to write down the correct location?"

"The customer wanted three! How hard can it be to count to three?"

"How can we be missing $10,000 worth of inventory?"

"How could he forget to load half the shipment?"

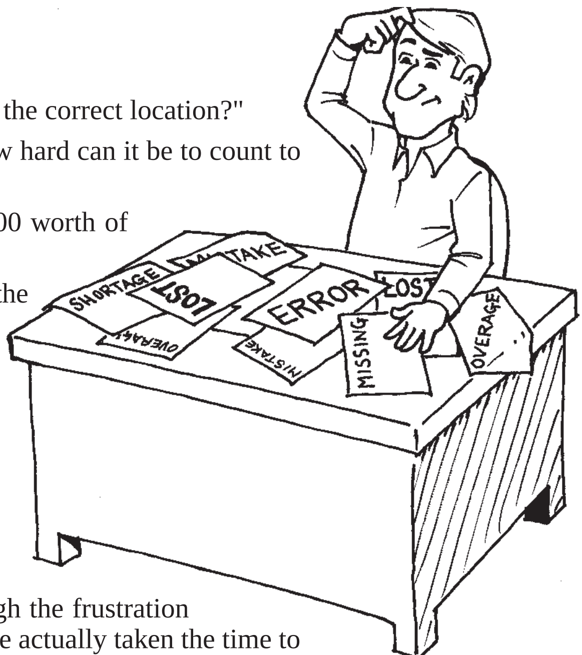
"Our employees are idiots!"

"They just don't care."

"They don't try."

"They don't think."

"They won't listen."



OK, most of us have gone through the frustration of inaccuracy. But how many have actually taken the time to try to understand how these situations occur? One of the most common mistakes made when addressing accuracy problems is applying solutions before the problem is fully understood. Often times, companies assume installing a bar code data collection system or implementing a cycle count program will automatically resolve accuracy problems. While both of these are very good tools, they do not guarantee accuracy, and in some cases may have little effect or even negatively impact accuracy. Understanding the nature of errors is critical to applying the appropriate solutions for the specific types of errors being encountered.

There are primarily two major types of errors — those caused by a lack of knowledge and those caused by a lack of focus.

Examples of errors caused by a lack of knowledge include:

Errors made when an employee doesn't understand unit-of-measure conversions and subsequently counts eaches as cases.

Errors made when an employee doesn't realize that the item he is handling is actually a kit and instead treats each component as an individual piece.

Errors made when an employee doesn't realize that when he picks item #XXX he must check the extended description and pick the color designated there.

Errors made when an employee doesn't understand how to use a counting scale and uses an inadequate sample size or incorrectly compounds the sample.

Incorrect cycle count adjustment made because the count administrator doesn't understand the allocation system.

Examples of errors caused by a lack of focus include:

Picking the wrong quantity of a part.

Picking the wrong item.

Missing a line item on an order.

Entering the work order number in the quantity field in production reporting.

Forgetting to enter a transaction.

Entering a transaction twice.

Transposing numbers or letters in an item number or quantity.

Errors caused by a lack of knowledge, although often more complex, are actually easier to prevent than those caused by a lack of focus. Employee training and process changes, such as changing the way a product is labeled, can often resolve knowledge-related errors.

Focus-related errors, however, are much more difficult to control. These errors are commonly referred to as "stupid errors" or "dumb mistakes," in that there seems to be no rational explanation for them. The worker understood what was supposed to be done, but simply was unable to execute correctly. Though it's unlikely you will ever completely eliminate these types of errors, you can significantly reduce them through process changes, training and application of technologies such as bar codes. But first you must understand them.

People have an impressive ability to make errors even under the best-designed processes and controls. I first recognized this ability (or force as I like to think of it) many years ago when implementing a locator system that allowed us to slot products randomly rather than in item number sequence as was previously necessary. Under the previous system, picking the wrong item was the largest source of errors. Since the items had to be stored in item number sequence, which also kept similar items together because the item numbers were assigned based upon commodity classification, you could end up with item XYZ321654, XYZ321645, and XZZ321645, all similar products, stored on the same shelf. It's easy to see how order pickers could mistakenly pick the wrong item.

With our new ability to slot an item anywhere, we were able to separate these very similar items and store them in various areas of the warehouse. So now a picker would be sent to a specific location and would be unlikely to find the previous level of item number and item commodity similarities within that location. Certainly this should eliminate our errors related to picking the wrong item, right? Wrong! While it did reduce this type of error, we eventually started to see errors where the pickers would pick wrong items that were either only slightly similar or not similar at all to the item they were supposed to pick.

So what happened? Well, in the previous system the employees needed to focus on the item number just to find the part. They also expected to find similar items stored in the same area, so consequently would focus more on the item number when picking the part. Under the new system, employees were sent to a specific location and expected to find dissimilar items stored there. They soon adjusted their picking habits to focus less on the item number and were either picking by description, location alone, or just looking for an item number that had some resemblance to the one they were supposed to pick (maybe just looking at the first few characters of the item number). In the end, even though we did make some gains in accuracy, we didn't see the level of overall accuracy improvement we had expected.

Over the years I guess I've become somewhat fascinated with this "force." To better understand it, you need to understand the way people process information, or data, to be more specific. Now, I have to make it clear that I have no formal education in cognitive science and no official credentials for discussing the complex workings of the human mind — but I'm not going to let that stop me. I have spent a lot of time analyzing errors and have developed some definite opinions as to how they occur.

Man versus machine

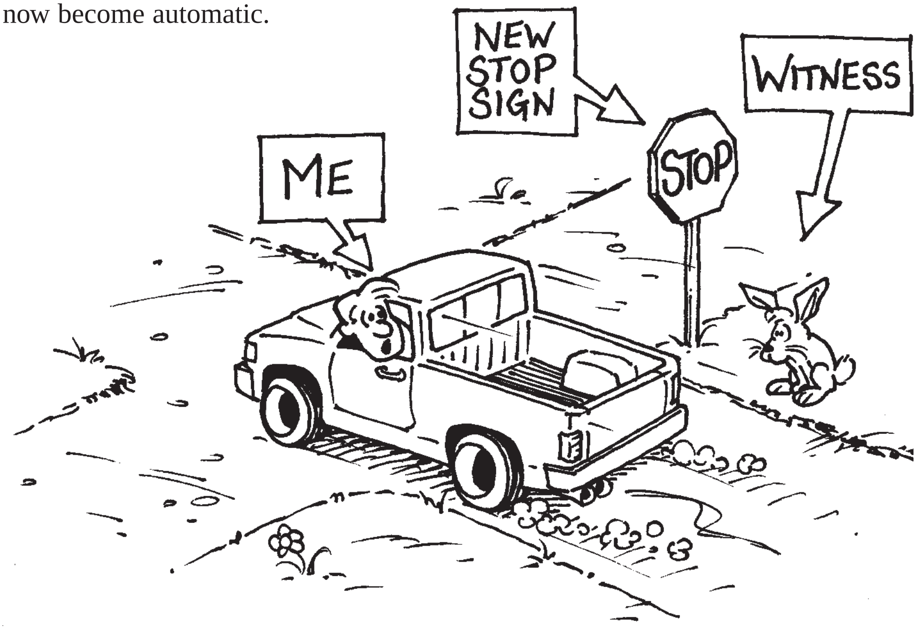
Consider how a computer processes information. Data is stored in a highly structured hierarchical format that consists of databases containing one or more files or tables that subsequently contain one or more records that contain one or more fields that ultimately contain the smaller pieces of raw data. To access a specific piece of data, a computer program must know the database and table the data is stored in. It will then use selection criteria based upon the data stored in a field or several fields (known as a key) to determine the specific record or records required. Once it has the record(s) it can grab the specific data required based upon the field names. Given the same input, the computer will give you the same output every time it is requested. Even when there are mistakes or bugs in computer programs, they will still provide predictable, consistent output (incorrect output in the case of a computer bug, but still consistent). If you specify that you want the shipped quantity from line #2 on order #12345 in the Sales Order Detail File, you can expect that given the same circumstances the computer will give you the same result every time and not return the shipped quantity one time and the line number the next time or the shipped quantity from line #3 or the date or location etc.

Unlike the computer, the human mind is organic in nature and does not use similar highly structured methods for interpreting, storing, and retrieving data. There is also less consistency in output given the same input. Do you ever wonder why (this is much more entertaining if you use Andy Rooney's voice in your head as you read it) one day you know something such as a date, an address, a company name, a phone number, a password, and another day you cannot seem to remember the information? Yet, days later, you suddenly know it again. Or how you can incorrectly remember information such as confusing a PIN number with an old password or giving out an old phone number rather than your current phone number? Or do you wonder how three people witness a crime and give three very different accounts of what they saw? Or how you can be thinking of a specific word or phrase, yet when you speak it comes out differently? While writing this book I have had several episodes of "what is that word I'm thinking of?" While I'm absolutely certain that there is a word and I know what it is, I just can't seem to access it at the moment. Eventually it will come to me. So what is that all about? I either know something or I don't, right?

The fact is, we really don't know exactly how we interpret, store, and retrieve data. Although I'm sure there is some structure to it, it obviously doesn't follow the same logic as a computer and is not a very highly accurate means of processing detailed data.

We also seem to process information at different levels of consciousness. For example, while driving home from work, you can be thinking about a problem you had at work or what you're going to do when you get home. You're really not paying much attention to where you are, what you have to do at the next intersection, or even whether your foot is on the gas or brake, yet somehow you seem to get home. This "running on automatic" mode primarily occurs when your attention is divided while performing a repetitive task; and while you do somehow manage to complete the task, you are more prone to err because the task is not getting your complete focus.

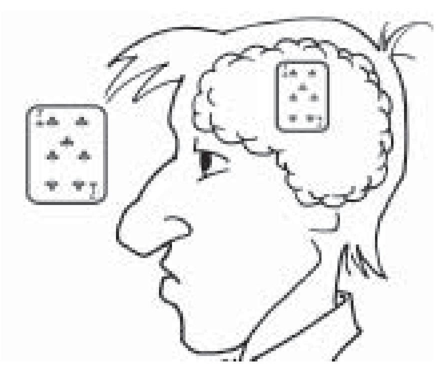
For example, one day you may need to run an errand on your way home from work. Yet, because you were running in automatic mode, you take your normal highway exit (the one before your intended exit). You were well aware that you were not going directly home, but you "spaced" for a moment and got off at your normal exit. Or, for a more dangerous example, on my route home from work, on a county road that I traveled daily for years, a four-way stop sign was added at an intersection that previously only required the cross traffic to stop. I knew the stop sign was installed, and, when focused on it, I had no problems. However, when I was thinking of something else (divided attention) and driving in automatic mode, I ran the stop sign once and had several abrupt stops before the stop sign finally became part of my automatic mode. I know my eyes saw the stop sign, but the visual image didn't convert into a thought to stop, because, while running in automatic, I wasn't using my complete focus. The information I was using to make driving decisions was based on a mix of what I expected to see — based on repetitive memory — and what I actually saw. Had this been the first time I had ever driven this road, I am certain that I would have stopped at the intersection. In fact, if the stop signs were now removed, I would probably occasionally stop at the intersection since stopping there has now become automatic.



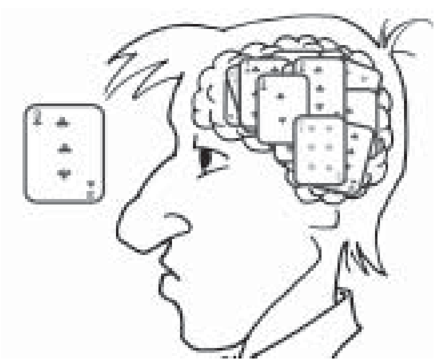
I like to use driving as an example because it is a repetitive and time-consuming task that most people can relate to. The more repetitive and time consuming a task is, the more likely you are to fall into the running on automatic mode. Repetitive and time consuming? Hey, that sounds a lot like work, doesn't it?

When a person processes data there are several points where an error can occur. First, you have the data input, generally in the form of visual or audible information that must be interpreted into a thought. The thought goes into memory and is then later retrieved from memory to perform an action. The action could be writing down a location or quantity, entering data into a computer, picking a specific item or quantity, etc. It's important to understand that an error can occur at any point in this process. People often don't realize that when an order picker reads a pick slip and then reaches to pick the item, he is using his memory to process this information. Though it may have been a split second between the time he read the information to the time he picked the item, it still requires the use of memory, and therefore can have memory-related problems.

Let me try to explain memory-related errors in repetitive environments another way. Say I told you to pick a card from a deck of playing cards and asked you to remember the card for 24 hours. I could probably ask you which card it was after a minute, an hour, or a day, and you would likely be able to accurately remember it. Now, say I told you to pick a new card every hour, and that you only had to remember that card until you picked the next one. You would probably be very accurate for the first several hours. However, eventually your memory would start to get cluttered with previous cards you picked. You would then run the risk of mistakenly remembering the card you picked several hours or days prior as the most recent card picked. Now imagine you are picking orders at a rate of one line every few minutes or seconds. It is very easy to read a pick but remember it incorrectly even a split second later.



Doing a task once and getting it right is easy.



Doing a task thousands of times and getting it right every time is more difficult.

For those of you starting to feel inferior to a computer, you should know that there is a strong desire to get computers to be able to think more like humans. Even though humans have problems consistently processing data at high levels of accuracy, they have an advantage over computers; they can make decisions based upon varying levels of input and can use any stored data (memory, experience) in the decision-making process. A computer requires a specific relationship to be predefined in order to use various pieces of data. That's how people can encounter a situation that they have never encountered before and never anticipated encountering, yet still make a decision for a specific action based upon the given circumstances. A computer, given incomplete or unexpected data, will either crash or do nothing.

By understanding the strengths and weaknesses of people and technologies you have the opportunity to design processes that best utilize the strengths of each to offset inherent weaknesses.

This ability to "fill in the blanks" and take an action even when only minimal data is available, has the negative side effect of sometimes filling in the blanks with incorrect information. This helps to explain the situation encountered when several people witness a crime, yet give different accounts of what happened. Each account of the crime is a combination of what the witness actually saw and what their brain assumed was also happening. The phrase "my eyes are playing tricks on me" should be replaced with the phrase "my mind is playing tricks on me" since it's your brain that is misinterpreting what you saw. The more focused you were on observing the crime, the more accurate your account will be.

This capacity to interpret is what currently separates man from machine. So what does this have to do with inventory accuracy? By understanding the strengths and weaknesses of people and technologies you have the opportunity to design processes that best utilize the strengths of each to offset inherent weaknesses.

Now let's go to some real world inventory-related examples of focus-related errors and possible explanations for the errors.

Paperwork instructs to pick two pieces and the worker picks one piece instead.

- ✔ There may have been another number on the paperwork with a one in it such as line #1, item number ending with a one or a location ending with a one.
- ✔ The previous or next pick on the paperwork may be for one piece.
- ✔ The last time the worker picked this part he picked one piece.
- ✔ The most common pick quantity for this item is one piece.

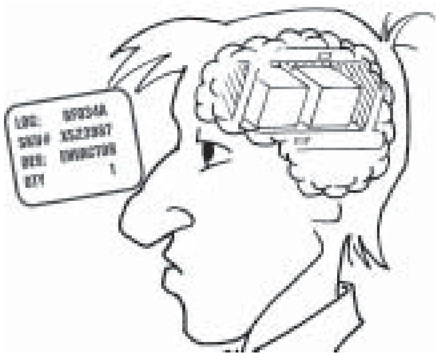
Paperwork instructs to pick one piece of a pump; item number XYZ12345 from location BX0240301 and the picker picks the wrong part.

- ✔ Picker may have transposed a number in the location, saw a similar item number there and picked it.
- ✔ Picker may have transposed a number in the location, saw a pump there and picked it.
- ✔ Picker may have gone to the correct location, and saw a similar part number or another pump and picked it.
- ✔ Picker may have looked at the location and description, and thought of another pump in that area that is picked frequently and picked it instead, disregarding any information on the paperwork.
- ✔ Picker may have looked at the item number and description, thought of another pump with a similar item number that is picked frequently and picked it instead even though the location is not even close.
- ✔ Picker may have gone to the correct location, identified the correct item, and then got distracted and physically grabbed the item next to or above the correct one. This is an error type that really surprises people after they implement a bar code validation system and find out that a picker scanned the correct location/item and then picked a different one.

Material handler picks the wrong quantity of a large quantity pick.

- ✔ Loses track during counting (…54,56,58,70,72,74…)
- ✔ Counts some of the pieces multiple times.
- ✔ Assumes wrong case or pallet quantity such as counting as cases of 36 even though marked as 24 because a similar product is stored in cases of 36.
- ✔ Math error in multiplying cases times quantity per case or layers times quantity per layer etc. (uses memory rather than a calculator such as thinking 12 x 12 = 244 rather than 144).

In this example, the "-3" in the SKU# is mistakenly retrieved from the worker's memory as the quantity.



Here the worker looks at the information and assumes it to be an item he regularly picks. His brain will now lead him to the item and location he remembers rather than that which is on the picking document. This is one of the most common types of picking errors.

The objective here is to build a level of understanding as to what drives the thought process in making these stupid errors. Rather than scratching your head, totally perplexed by these errors, you can begin to use your knowledge to explore possible solutions. It's also a good idea to educate workers to help them better understand how they make errors. Only in understanding errors can you truly hope to control them.

Environmental factors

While we've discussed the two major types of errors and the thought process that affects them, there are many additional factors that affect accuracy. I've often said that virtually every decision you make when designing storage and material handling facilities and processes will have some effect on accuracy. While accuracy considerations may not be great enough to change some of these decisions, the knowledge of how these decisions affect accuracy will allow you to develop processes and procedures that take into account the error potential associated with the decision.

Lighting.
Lighting in the warehouse and on the shop floor affects accuracy in several ways. Inadequate lighting can make it difficult to read documents, computer screens, product labels, and portable terminal displays, increasing the opportunity to make

errors. In addition, poorly lit facilities can also affect employee morale resulting in an "I don't care" mentality.

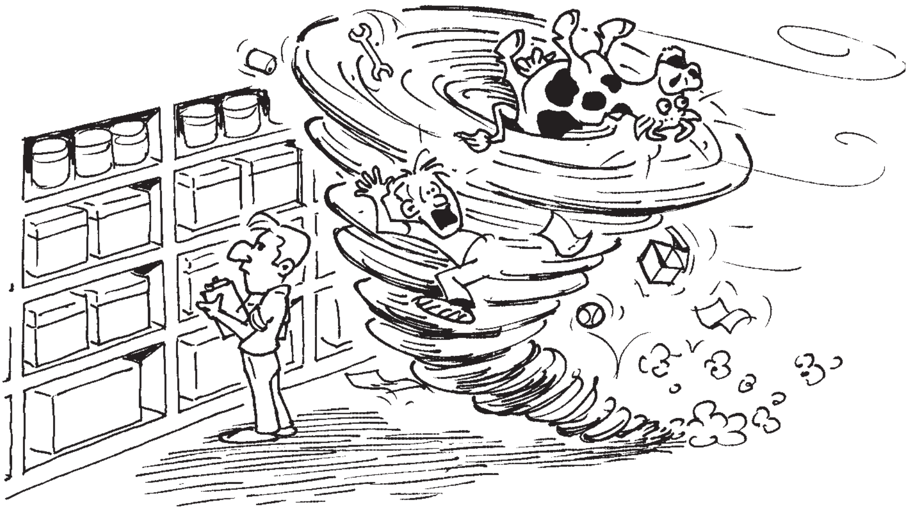
Don't assume more lighting is always better. In some cases lighting can cause excessive glare, especially when using hand held terminals or when lift truck operators have to look towards the light when placing pallets in tall pallet racking. Lighting technology is constantly changing and there is a lot more science being applied to lighting decisions than in the past. It's advisable to use a commercial lighting consultant when evaluating lighting in storage and production areas. Make sure the consultant understands the activities taking place in each specific area as well as the types of documents, equipment, computers, and portable devices being used. If the consultant doesn't show an interest in this level of detail, I would suggest finding another consultant.

Ways of compensating for poor lighting can include using larger, bold fonts on paperwork and labels, glare filters on computer screens, larger fonts and backlighting on portable displays and adding task lighting and spotlights on lift trucks and material handling equipment.

Noise.
Noise is unavoidable in most manufacturing operations as well as distribution operations that use a lot of automated conveyor systems or internal combustion lift trucks. While noise is primarily a safety issue, it should also be considered as impacting accuracy. For those that may doubt noise can affect work performance, I suggest you move your desk onto the shop floor next to a machine for a day and see for yourself. Anything that distracts a worker or affects their ability to concentrate will potentially impact accuracy.

Temperature.
Like noise, temperature is another environmental factor that can have an effect on accuracy as well as productivity. Workers in cold storage areas will have a difficult time writing information on transaction forms or entering data into portable terminals. Extra measures should be taken to minimize or eliminate the need to do this. Excessive heat tends to be more of a productivity issue than an accuracy issue; however, it can have an impact on accuracy by reducing an employee's ability to concentrate or when paperwork is lost or mixed up through the use of fans. Temperature can also influence the effectiveness of equipment related to accuracy. Portable terminal displays may have problems in extreme environments such as cold storage areas, and scales used to weigh and count materials are designed to work within specific temperature ranges.

Weather.
Inventory losses can occur whenever inventory is stored exposed to the elements, such as water damage, heat/cold related damage, UV exposure damage, and theft. Outside of these obvious problems, there are some other process related special considerations. Product identification such as labels must be able to withstand the elements; this not only includes special label stock and adhesives, but also



printing techniques that won't fade or run. Bright sunlight can also prevent laser scanners from reading bar codes. Certainly, whenever the ability to identify the inventory is compromised, you have increased your risk of errors.

Housekeeping.
Housekeeping can have a significant impact on accuracy as well as productivity and safety. Allowing damaged cartons, gaylords, or other types of containers, or allowing unstable loads to be placed in racking or stacked in floor locations, will eventually result in damaged product or loose product falling on the floor in between loads or racking. Allowing trash to pile up may provide an opportunity for mistaking product for trash. Allowing cluttered aisles and storage areas will result in damage to products by lift trucks and other equipment. Damaged product is a high risk factor for inventory problems because it is often disposed of without the appropriate transaction being entered. Cluttered areas also become "black holes" for lost inventory. Poor housekeeping often allows product to span or share multiple adjacent storage locations, adding confusion to cycle counting and order picking operations. Allowing product to be staged anywhere, such as in aisles, under conveyors, and behind machines, makes it difficult to determine what is supposed to be there and what was mistakenly placed there (lost). Allowing work stations to be cluttered and allowing trash to be left on the floor makes it easier to lose documents that are needed to make inventory related transactions.

In addition to the direct effect on accuracy, you also have the indirect effect that poor housekeeping has on employee morale that eventually affects accuracy. Allowing storage areas and work areas to be dirty and cluttered conveys a message of "we don't care" to the employees. And if you don't care, you can be certain that ultimately they won't care. I'm not saying that every facility can be perfectly organized and spotless all the time. The nature of the activities in a facility, as well as the type of materials being handled, will change the definition of good housekeeping from one facility to another. For example, if you use loose fill in your shipping or receiving areas it is near impossible to prevent some of it from falling on the floor. While you could require employees to pick it up every time a piece hits the floor, you will more likely find a policy of having the floor swept every four hours, every shift, or at least once per day adequate.

Inventory characteristics.
Bulk dry goods and liquids stored in large tanks would obviously have different accuracy characteristics than discrete products such as automobiles or manufacturing equipment. Rolls of steel would have different accuracy characteristics than pre-cut steel sheets. While you're unlikely to change the materials being handled because of accuracy characteristics, you certainly should be taking these characteristics into consideration when developing processes and procedures.

Item packaging/containers.
In addition to the characteristics of the materials being handled, the packaging or containers used to protect and contain the materials for storage and transport can have a significant impact on accuracy. In an ideal environment, you would have all of your materials broken down into a few product groups. Each product group would be stored in standardized containers with standardized quantities per layer within the container. You would have standardized quantities per container and standardized quantities of containers per pallet. All materials would also be received, consumed, produced, and shipped in these same standardized full pallet or full container quantities. Yes, these environments do exist. Unfortunately many operations will find this level of standardization impractical.

Containers can be bags, cartons, totes, gaylords, crates, hoppers, pallets, barrels, tanks, etc. There are various levels of standardization that can be applied:

Same item/container/quantity combination each time a specific item is purchased or produced.

Same container/quantity combination for groups of products.

Use of inner packs (also known as unit packs) such as bags, smaller boxes, dividers, and layers. The use of layers within cartons, totes, gaylords, crates, etc. (usually just a piece of flat cardboard) can often be a very simple means of increasing accuracy; the idea is each layer contains the same quantity of materials arranged in a pattern that greatly reduces or eliminates the possibility of a miscount. Inner packs are also very useful in preventing product damage.

Forcing order quantities, sales quantities, move quantities, and manufacturing production and usage quantities to be exact multiples of container quantities.

The just-in-time movement of the last few decades presents conflicting messages towards standardized containers. On one hand, JIT promotes standardized containers through its efforts to eliminate waste (counting is waste, repacking and returning materials is waste, damaged materials is waste, etc.). At the same time, the JIT move towards ordering just what is immediately needed for components and raw materials and smaller lot sizes, ultimately driving towards one-piece-flow for manufacturing, does not easily coexist within the rigidity of a standardized container/quantity system.

The message to be learned here is that a well thought out strategy that incorporates standardized containers and quantities wherever practical, can provide increases in both accuracy and productivity without negatively impacting overall business strategies. You may find that you can only incorporate this level of standardization with certain product groups or suppliers.

Item identification.

Product identification consists of both the part numbering scheme and the actual physical identification of the product.

The first dilemma encountered when setting up a new inventory system is whether you want to build meaning into your part numbering scheme, and, if so, how much? Meaningful part numbers have historically been the method of choice, however, recent trends are leaning more towards random, meaningless part numbering schemes.

Logic that has been put into part numbers has included:

Product group identification such as sales categories or purchasing commodity classifications.

Vendor identification and/or vendor item number.

Customer identification and/or customer item number.

Product specs such as dimensions, weights, or composition, version identification, color, flavor, facility identification, etc.

The problems associated with building meaning into part numbers include ending up with very long, difficult to use part numbers as well as numbering schemes that are difficult to maintain as new product and product lines are added. With the extensive databases available in most modern inventory management software there is little value to placing this level of information in the item number. If the use of this information is primarily for grouping items for reporting and analysis purposes or for people working at a computer terminal, the information is much better placed in separate fields in the database.

I must admit, however, that I do prefer a little meaning in the part number. For people working in the warehouse, shipping, receiving, or on the shop floor, there is some value in being able to quickly identify the major product group the product belongs to by the part number alone. For example, if I worked for a distributor of computer products I would like to know whether an item was a hard drive, a video card, a memory chip, or a software product by the item number. I would probably not want to try to integrate the vendor identification, model identification or specs into this system. If I worked at a manufacturer that made products that were unique by customer and had only a few customers, I might like the item number to identify the customer. I would probably keep this meaningful portion of the item number to fewer than four characters and have the remaining portion of the item number meaningless.

Another decision related to part numbering schemes is whether the part numbers should be numeric, alpha, or a combination. Purely numeric part numbers provide the quickest data entry but are more prone to transposition errors. A random mix of alpha and numeric characters in item numbers (example: 8FP37W95Q) can make the part numbers difficult to read and enter. Combinations of grouped alpha and numeric characters (such as all items start with three alpha characters and end with four numeric characters, example: BRK4583) tend to be easier to read and reduce problems associated with transposing characters. The primary down side to using alpha characters is their effect on data entry. Entering purely numeric data on the 10-key numeric keypad located on the right of most keyboards is significantly faster than entering alpha or alpha/numeric combinations. Also, if you plan on using portable hand held-terminals, you will find entering alpha characters on them is extremely difficult. A solution to alpha data entry productivity problems is to use bar codes as much as possible for high transaction tasks.

It's generally not a good idea to include special characters such as hyphens, periods, commas, spaces, etc. in part numbers. To make part numbers more readable on documents, packaging, and labels, you can program the computer system to insert a space or hyphen in a specific position to help break up the part number. Your credit card number is an example of this; your card and associated documents may insert a space or dash every four characters to make the number easier to read, however these spaces or dashes are not actually part of your credit card number. Other similar examples are Social Security numbers and phone numbers. While the parentheses, spaces and hyphens make a phone number easier to read, you certainly wouldn't want to have to enter them when making a call.

So how long should your part numbers be? You need to take into account potential future growth (what is the maximum quantity of part numbers you will ever need?), accuracy, and productivity. Long part numbers are more difficult to read, more difficult to enter, and more highly prone to data entry errors. However it is less likely that transposing characters in a longer item number will result in entering another valid part number (in other words, the computer system will

Item Numbering Schemes:

SKU# 473810923847928	*(too long)*
SKU# 7342	*(too short)*
SKU# 3L80BQ98R7	*(too confusing)*
SKU# BPX7349	*(good compromise)*

probably notify you of your error). Short item numbers make it easier to mistake one item for another, or, if you make a data entry error, you are more likely to accidentally enter another valid part number (therefore, no system generated error message).

As a general recommendation, most businesses should find that item numbers between six and eight characters in length, containing a combination of grouped alpha and numeric characters, with some general meaning built into two or three characters, should provide a good balance for a part numbering scheme.

The methods used for the physical identification of materials should also be considered very carefully. Physical identification can include everything from an SKU label on a small parts bin or large container for bulk materials, to individual product packaging or labels, to compliance case labels, to pallet license plates. Poor product identification practices will certainly contribute to inventory accuracy problems. More information on physical identification of inventory is covered in subsequent chapters.

Storage methods.

Different storage methods can have very different accuracy characteristics. While it is unlikely that accuracy will play a key role in storage method decisions (productivity and space utilization will ultimately drive these decisions), processes and technologies can be put in place to reduce or eliminate accuracy issues related to a particular storage method.

Random versus fixed locations. In a fixed locations system, each SKU is assigned a specific location or locations and will always be stored in these predetermined locations. Random location systems allow materials to be stored in any available location. Fixed location systems are inherently more