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CONSULTANTS • ENGINEERS • STRATEGISTS

Cycle Counting & Inventory Record Accuracy

There's More To Cycle Counting Than Counting

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Inventory Accuracy

What Is Inventory Record Accuracy?

Inventory Record Accuracy(IRA) is a measure of how closely official inventory records match the physical inventory. Many managers equate IRA with cycle counting, but there is a lot more to inventory accuracy than just counting.

The units of measurement for accuracy are either dollar based or count based. These two bases have different purposes and may give widely differing results. Accountants and financial auditors prefer dollar-based measurements. Their concern is to ensure that the inventory value stated on books and tax returns is accurate at an aggregate level. Discrepancies on individual items hold little concern provided that positive and negative discrepancies are roughly equal and the total value is the same.

Operations and material management people have a stronger interest in the accuracy of individual SKUs. If one SKU is short, they can rarely substitute some other part or item that happens to be long.

Why Is It Important?

The reasons for having accurate records are legion. Here are a few of them:

Financial Reasons:

- Investors want to know that the book value is accurate.
- Lenders who loan money with inventory as collateral want to protect their loan.
- Taxation often depends on inventory value. Overpayment of taxes reduces profits and underpayment can incur severe penalties.
- Poor accuracy begets more inventory and requires more capital. Inventory is often the largest consumer of capital for an enterprise.

Operational Reasons:

- Stockouts interrupt production and create delivery delays.
- People waste hours looking for misplaced or missing items.
- When stockouts are frequent, inventory rises in an attempt to compensate. This unnecessary inventory requires space and capital.
- Stockouts increase cost in a hundred ways and sap the time and energy of everyone. .

- Inventory turnover reflects overall manufacturing efficacy.
- MRP and ERP systems require very high accuracies (95%-99%) to function well.

IRA & Lean Manufacturing

Lean Manufacturing reduces the need for inventory and transaction volume. It makes high accuracy easier. However, this takes many years and inventory will be with us for a long time.

The stockouts common to firms with poor accuracy generate significant fears throughout the organization and create complications for a lean implementation. Because of this, increasing inventory accuracy may be a necessary part of a lean manufacturing strategy.

Reasons For Inaccuracy

There are many causes for inaccurate records. People may enter data inaccurately or not at all. Confusing location codes cause discrepancies between recorded and actual locations. Occasionally, software bugs introduce errors. The thousands of possible causes are either process-related or volume-related.

Process Related Errors—Each step in a transaction process introduces some probability for error, even if that probability is small. To reduce process-related errors, we must change the process.

Volume-Related Errors—Every transaction process has an inherent error rate resulting from the process. Over time, and with many transactions, the number of new errors per week or per thousand transactions is relatively constant, if the process remains unchanged. The more transactions, the more errors. If transaction volume is reduced through kanban, backflushing, Cellular Manufacturing or other simplification, errors drop proportionately.

Methods For Improving Accuracy

To improve inventory record accuracy, the error creation rate (i.e. errors per week, month, etc.) must be less than the error removal rate. to increase accuracy we can decrease errors flowing in or increase the removal rate.

Methods to improve accuracy include Cycle Counting, Physical Inventory, Transaction Reduction and Process Improvement. An optimal approach may use them all.

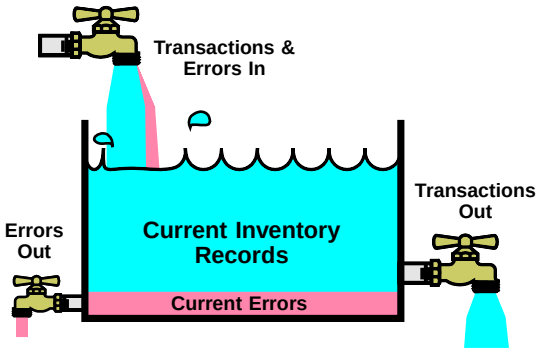


Figure 1 Inventory Error Rates

Physical Inventory— In a physical inventory, normal operations cease while a physical count of every item is conducted. The counts are compared to inventory records and, when necessary, the records are corrected.

Cycle Counting— A small number of items are physically counted, daily, on a random or semi-random basis. The physical count is compared to the inventory record. When necessary, the records are corrected.

Process Improvement— Process Improvement examines the transaction processes. Changes are identified that reduce the probability of error.

Transaction Reduction— An effective way to reduce errors is to reduce the number of transactions. Fewer transactions introduce fewer errors. Kanban, BOM simplification, cellular manufacturing and other elements of Lean make this feasible.

Cycle Counting

What Is Cycle Counting?

Cycle counting finds and corrects inventory record errors. Cycle counters select a small sample of inventory items for audit each day. The selection is random or semi-random. When they find errors, they immediately correct them. Cycle Counting removes errors from the system, much like a physical inventory, but has significant advantages.

Cycle Counting Can...

- Achieve Very High Accuracies
- Level the Workload
- Reduce Inventory
- Continuously Measure Inventory Accuracy
- Function without Interruption of Operations
- Facilitate Process Improvement
- Eliminate The Annual Inventory Audit

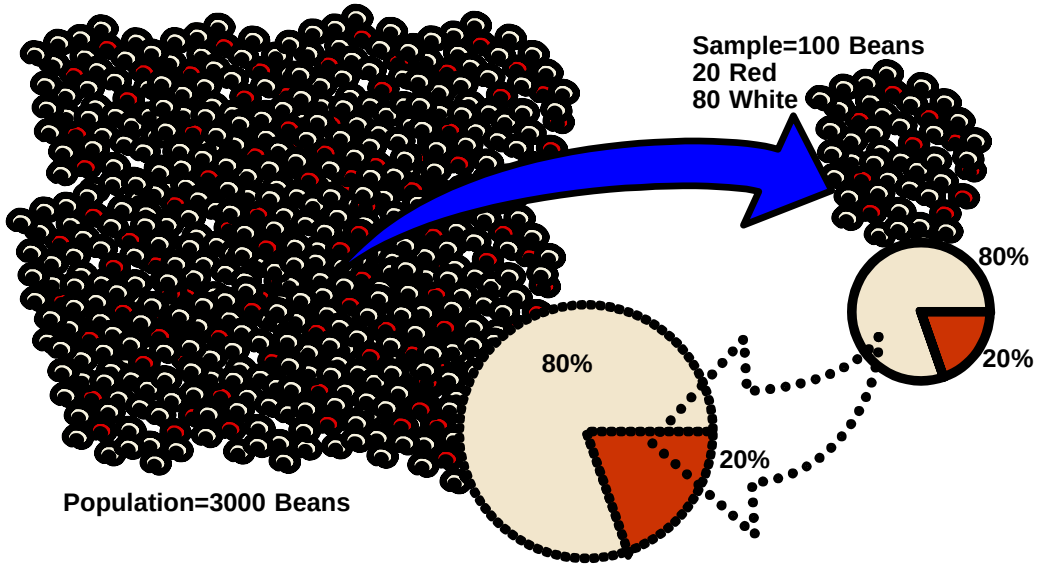


Figure 2 Statistical sampling

Cycle Counting Example

Cycle Counting uses the principle of *statistical inference*, just as in opinion polling. In figure 2, we take a random sample of 100 beans out of the "population" of 3000 beans. If 20% of those beans are red, it infers that 20% (600) of the population is also red.

Imagine each bean is a different inventory item and the red beans are items with erroneous records. If we cycle count 100 items (beans) and correct any errors in the records, we have estimated the accuracy of our inventory records (80%) and removed 20 errors.

Repeated over time, the process measures and improves Inventory Record Accuracy—provided that errors are removed faster than they are being introduced. A running chart, as shown in figure 4, thus shows whether the weekly volume of cycle counts is adequate.

Estimating the number of counts required each week and the staffing required to do them is always an issue when starting a new program. We address this in our training program, "Cycle Counting and Physical Inventories."

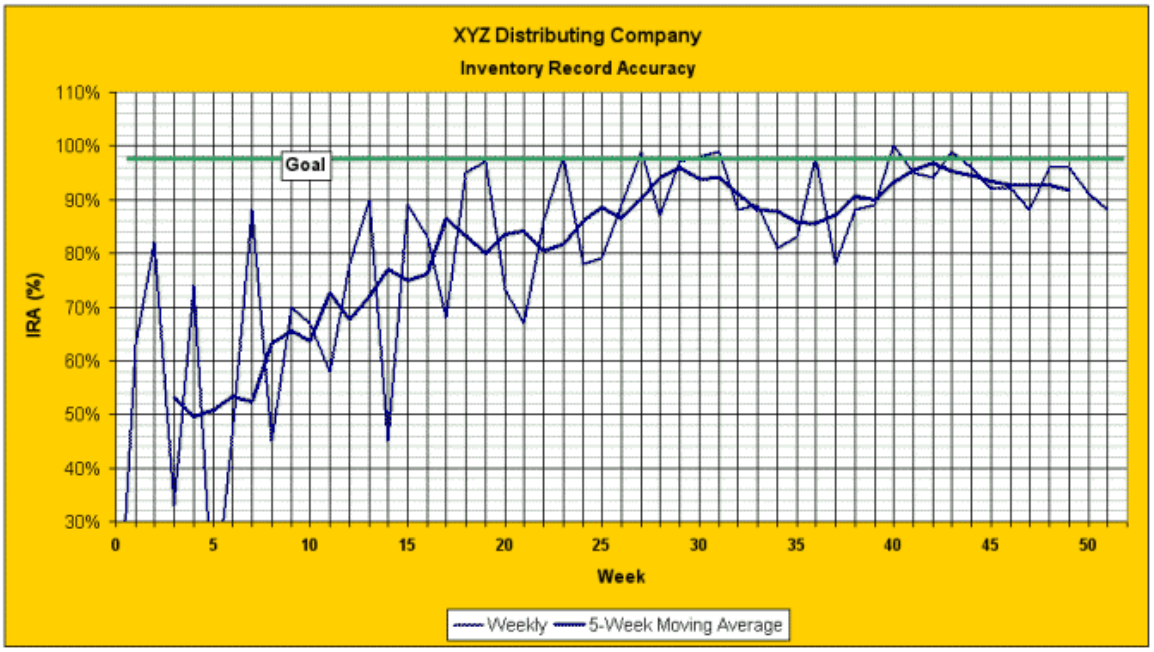


Figure 3 cycle counting Example

Figure 3 shows the results of a typical cycle counting program. IRA percentages in the first five weeks showed an accuracy of about 52%. As the program removed errors from the system, accuracy increased to about 96% by week 28.

The drop in accuracy from week 28 through week 35 indicates some change in the system. `Fewer counts, perhaps, or volume may have increased or new employees may have introduced more errors.

Corrective action was taken about week 36 and accuracy rose again until about week 40. From week 40 through week 52 the system is stable at about 93%. To improve further, the organization must reduce the input error rate, reduce transaction volume or increase the number of weekly cycle counts.

Improving Count Effectiveness

Cycle counting can require large efforts, especially when IRA is in the 90%+ range. To improve error detection and reduce the number of counts required, several techniques are available.

Segregate By ABC— A-B-C classification applies to cycle counting as well as to other areas of inventory management. The highest cost and most important items (A-Items) get counted most often.

Zone The Counts— this technique groups daily counts into the same zone or area to reduce travel time for the counters.

Zero on Book Condition— This guarantees either a fast count or an error discovery.

Zero on Shelf Condition—Another guaranteed fast count or error discovery.

Negative Balance— A guaranteed error discovery.

Hazards In Cycle Counting

Insufficient Staffing—This usually results from underestimating the number of counts required when the program is initially developed.

Diversion of Effort—To the rest of the organization, cycle counting does not seem to accomplish much of immediate importance. Cycle counters become a convenient source of staff for all sorts of odd jobs that arise. Over time the practice of borrowing cycle counters dilutes the effort and reinforces the perception of non-accomplishment.

Ignoring Error Creation—Error prevention is always more productive than correction. Some systems create errors so fast that it is impractical to cycle count enough for high accuracy.

Insufficient Training—Cycle counters need training on counting properly and also on resolving discrepancies. Others in the organization need training to support the program.

Motivation—Cycle counting tends to be boring and specific means should be employed for recognition and rewards.

What To Expect

Cycle counting, by itself, takes considerable time to show results. As accuracy rises to the 90% range, further results are even slower because each weekly sample contains fewer and fewer errors. Figures 4 illustrates.

With insufficient staffing and counting, the IRA curve can rise much slower or even decline as counters struggle against a tide of new errors. The key to improving effectiveness at high accuracies is prevention through reducing transaction volume and reducing transaction errors.

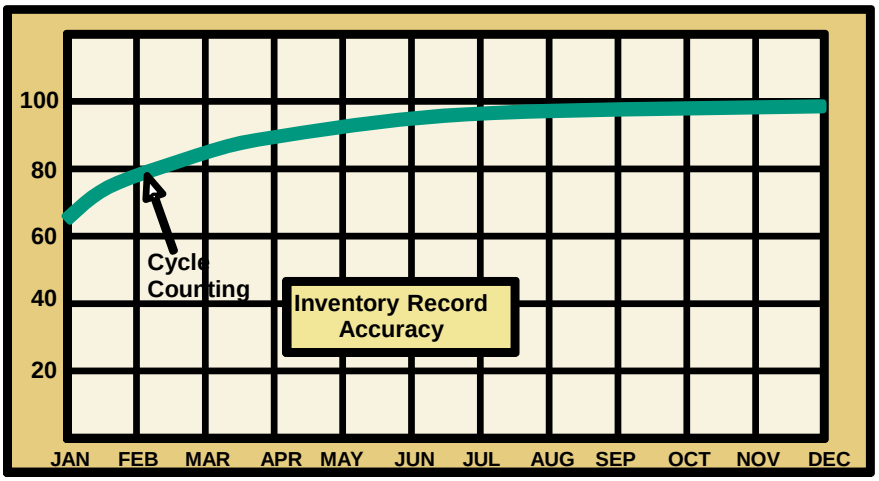


Figure 4 IRA with cycle counting

Reducing Inventory Errors

An Ounce of Prevention...

Reducing the input error rate is one of the best ways to improve accuracy, but few firms do it well. All the more strange because the tools and procedures are simple old stand-bys from Work Simplification and TQM: fishbone diagrams, process charts, pareto charts, five why's and teams.

In some firms, Root Cause Analysis consists of finding someone to blame. Real root causes are usually systemic; not personal.

Root Causes of Inventory Record Errors

The fishbone diagram of figure 5 (a.k.a. Ishikawa chart, cause & effect chart), shows some common inventory errors and their possible causes. The red envelopes highlight some of the more prevalent and overlooked causes of errors. Dashed purple lines illustrate how any branch can be expanded, digging further and further towards the real root cause.

This is not a complete summary of causes; nor does it drill down to all root causes. It is, however, a good start.

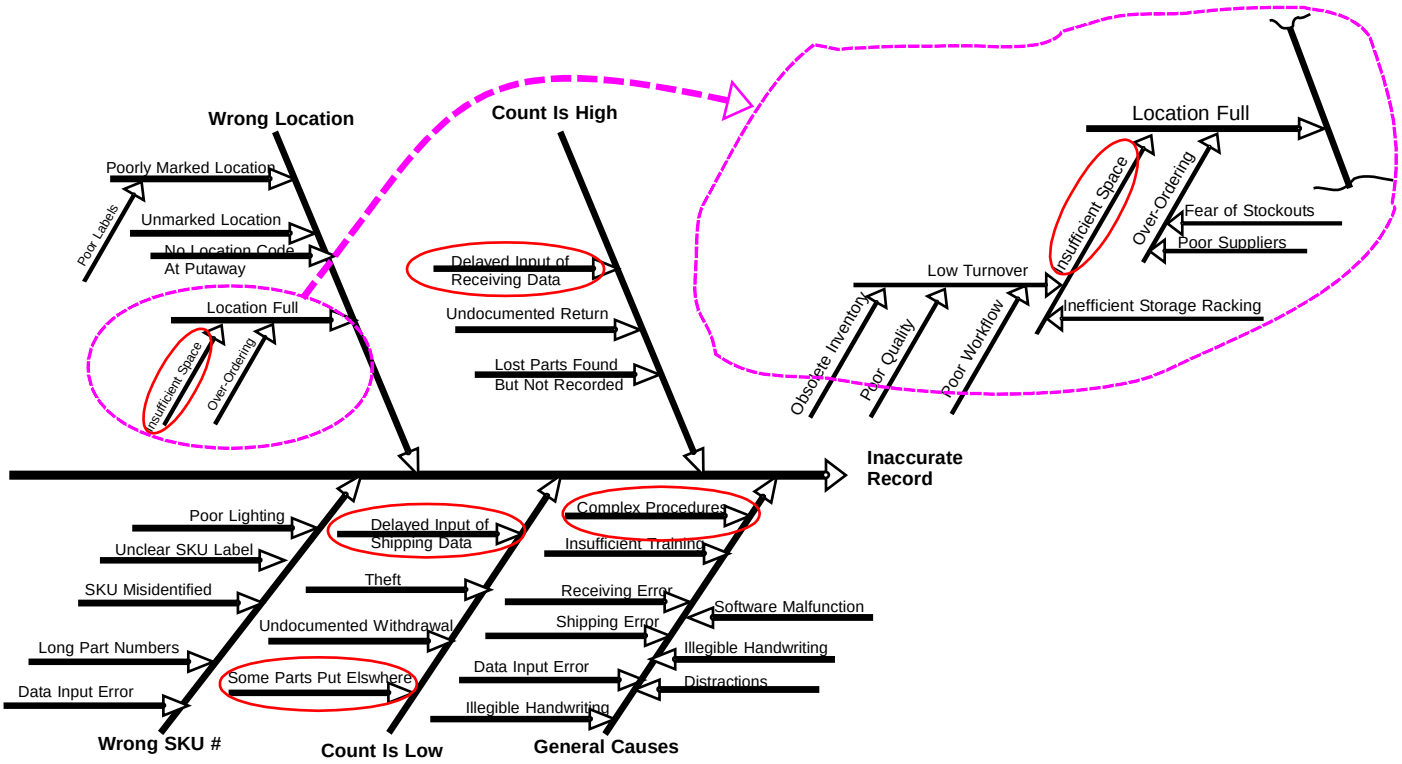


Figure 5 Inventory Error Causes

Reducing Inventory Transaction Volume

More Transactions, More Errors

Error creation rate is roughly proportional to the number of transactions. Many systems require far more transactions than necessary and, thus, accumulate more errors than necessary. These errors must then be removed with cycle counting or physical inventory.

Reducing transaction volume improves accuracy and reduces cycle counting labor. It also reduces transaction input labor. In some instances, the cost of transactions can exceed the cost of the items being tracked!

What Drives High Transaction Volume?

Complex Processes

Some inventory systems have excessive transactions because the underlying manufacturing process is complex and disjointed. Figure 6 illustrates how a functional layout and organization has complex material flows. The system may require two transactions for every material move.

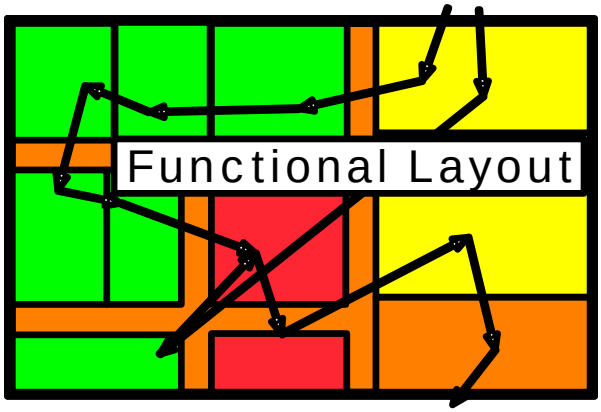


Figure 6 Material Moves In A Functional Layout

Data-Equals-Control Fallacy

People sometimes assume that more data makes for better control. However, this is only true when the data is both manageable and well-managed. It must be accessible, well-formatted, concise and monitored frequently. Many inventory systems are built with far too many transaction points under the assumption that this gives better inventory control.

One Method For Everything Assumption

Another unspoken assumption that sometimes underlies scheduling and inventory systems is the idea all products and processes should use a single method. This needlessly complicates a system. Most factories have a wide variety of products, volumes and demand characteristics. Some are amenable simple, visual control while others are not. If one method is used for everything, that method is usually a complex computer-driven MRP/ERP system.

Unnecessary Data

Inventory system designers may collect data because it seems easy and the data might be useful. This may include unnecessary transactions. Once installed, the transactions are institutionalized and rarely get reviewed for necessity.

Reduce Transactions With...

Cellular Manufacturing
Cellular layouts can reduce material moves and transaction volume by 80% or more. compare figure 7 with figure 6.

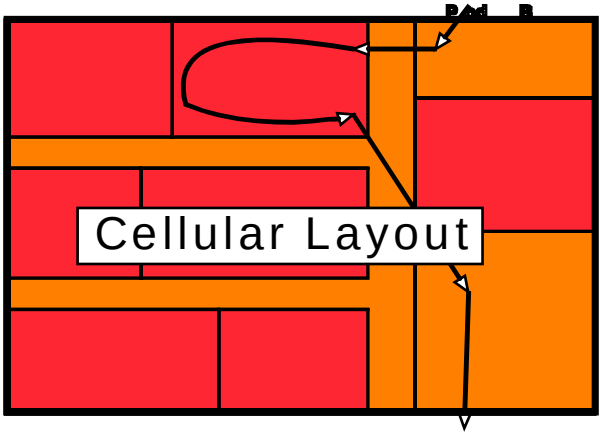


Figure 7 Cellular Layout Flow & Transactions

BOM Simplification
Complexity and unnecessary transactions may result from complexity in the BOM. Multiple layers of subassemblies seem to lend order and logic. Or, they may be service parts. These extra levels then carry over into manufacturing. The result is unnecessary inventory and transactions. BOM Simplification Example

Backflushing
In Backflushing, the inventory system is setup to relieve inventory of piece parts when a transaction is made for completion of an assembly. There may be several levels of subassembly in the BOM that the system assumes takes place. Backflushing and phantom subassemblies are alternatives to restructuring the BOM.

Kanban, Broadcast, Direct Link & ROP
Kanban and broadcast are simple visual systems that operate outside the MRP framework. Used appropriately, they can simplify the scheduling and inventory system. for more on this, see our page on Integrating kanban and Other methods.

Simplifying The BOM

Bills of Material (BOM) in many organizations are unnecessarily complex. Excess complexity increases the number of transactions, computation time for an MRP system, work orders and errors. It also leads to unnecessary “kitting”. BOM complexity increases the effort required for cycle counting.

The key to BOM simplification is simplification of the process. When subassemblies are combined into a single assembly operation on the plant floor, it reduces the need to carry inventory and track inventory at the subassembly level. Linking subassembly operations to the main assembly with Direct Link or Kanban achieves the same result.

A BOM Simplification Example

In the example below, a simple peristaltic pump had three levels of subassembly. By building the entire pump in one location, the company flattened the BOM to a single-level. In addition, most parts were floor-stocked which further reduced warehouse inventories and transactions. The result was a 26% reduction in part numbers and associated transactions.

Most BOMs have more than the three levels in this example and the resulting benefits of simplification are correspondingly greater.

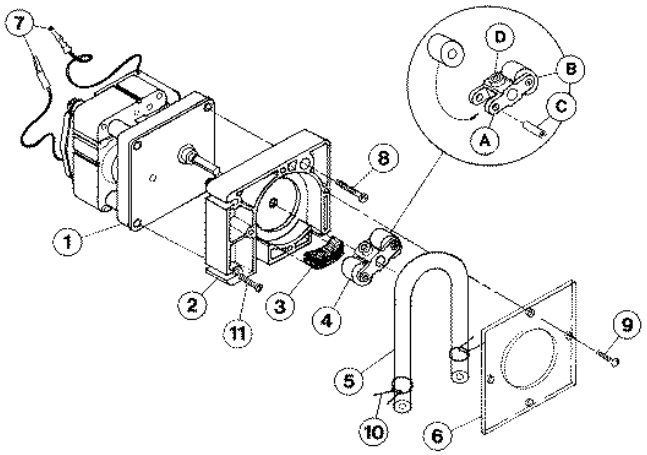
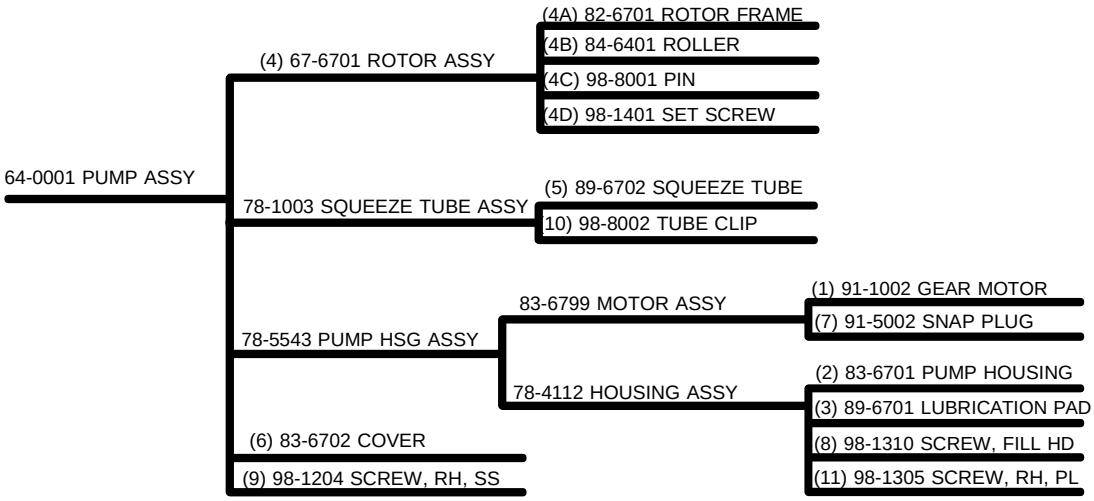
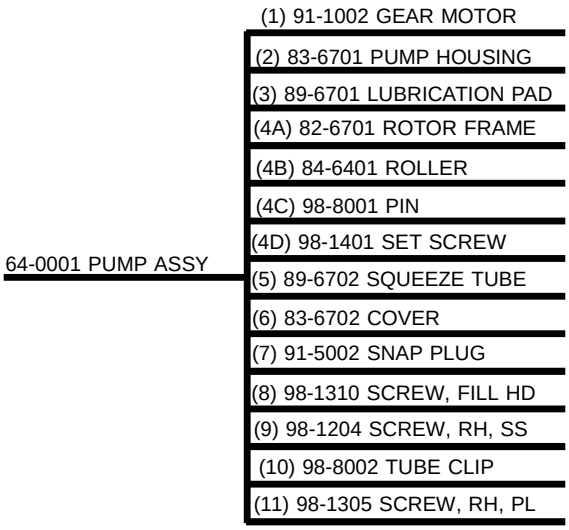


Figure 8 Peristaltic Pump



Original 3-Level BOM

Figure 9 Original 3-Level BOM



Simplified 1-Level BOM

Figure 10 simplified BOM

Physical Inventories

The Annual Inventory

In a physical inventory audit, normal operations cease while every inventory item is identified and counted. The physical counts are then compared to records and, where necessary, the record is corrected.

Most firms conduct the physical inventory for financial reasons. However, it also has the effect of correcting errors and improving cycle count programs. Within a few days, accuracy can increase, quickly and dramatically to 98% or more.

Then, as figure 2 shows, accuracy begins to drop the moment operations resume. Transactions introduce errors. At one year, accuracy will drop to the initial level, other factors being equal.

Figure 2 shows an initial IRA of 63%. Such a low figure is not too unusual. After the annual inventory in January, IRA rose to about 99%. It then steadily declined to the original 63% by the following December. This gives an overall average of about 80%.

This could be improved by taking a physical inventory every six months. However, this is expensive and frustrating for people. It still gives only a 90% average IRA and this is insufficient for MRP/ERP systems. It is undesirable even in manual systems.

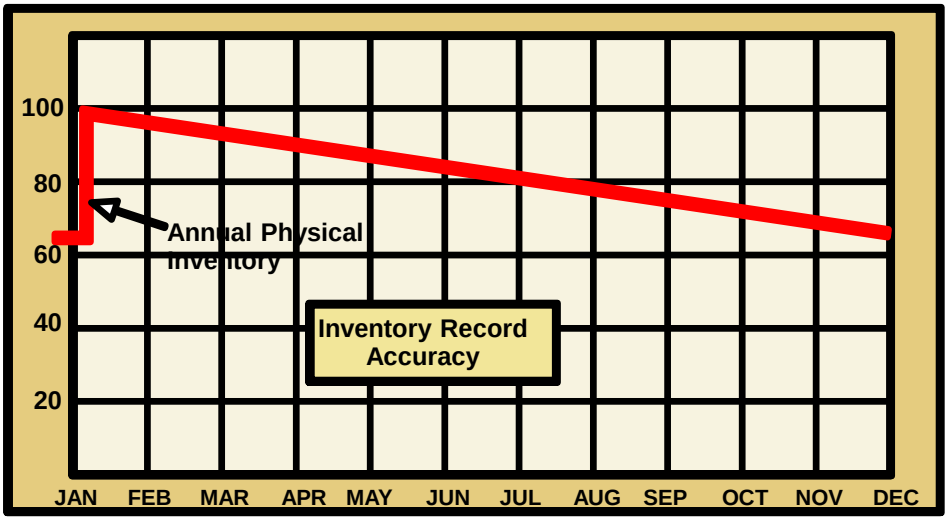


Figure 2-IRA With Physical Inventory

Conducting A Physical Inventory

The annual physical inventory is all too familiar to most manufacturing people. For many, it is an unpleasant experience of chaos and boredom.

A physical inventory is expensive. It usually involves overtime and sales may suffer. If the result is inaccurate, the money is wasted.

Planning Your Physical Inventory

The key to an accurate, sane and fast inventory is planning. Begin planning at least twelve weeks before the count. Include at least the following:

1. Set The Count Date(s)
Do this early so everyone has notice. Avoid dates when people are preoccupied such as the days around Thanksgiving and New Year. with several locations, consider counting them on different dates.

2. Select The Method
Bar-Code Readers— Bar Codes make counting simpler, faster, easier and more accurate. However, they are expensive and require labels on every bin or product.

Count Cards— Count cards (cards for each product and location) are a "low-tech" alternative to bar-code. Place these cards on shelves or bins before the count starts to allow a sequential count. This facilitates the discovery of "lost" material. Provide each counter some blank cards for newly discovered items.

Count Sheets— Count sheets (8-1/2" x 11" with about 25 items) are easier to handle than cards. However, because multiple items are listed on a sheet, counters may be tempted to only count the items printed, and overlook misplaced material or products. Sheets usually give less accurate counts.

3. Identify The Counters
If you are using bar code equipment, one person can count a section of your warehouse. With count cards or sheets two-person teams work better. Pair an experienced employee with someone having less knowledge the material.

Order Supplies—Supplies may include count cards, bar code readers, clipboards, and computer paper.

Police The Area—Clean out the junk, return everything to its proper place, mark all locations and scrub things down. Do this at least two weeks prior to the count.

6. Train People
Almost everyone who participates will require at least some training. Among the topics are:

- Material Types & Locations
- Counting Methods
- Safety Procedures
- Documentation Procedures
- Reconciliation Procedures
- Handling Equipment Operation

Implementing Cycle Counting & IRA Improvement

Cycle Counting Is More Than Counting

Improving inventory record Accuracy is a worthwhile and necessary goal for most firms. Cycle counting and physical inventories both correct problems after the fact. Ben Franklin had a thought about this and Shigeo Shingo would probably have dismissed both approaches as wasteful and wrong. Nevertheless, most of us are stuck with these approaches, at least for some period of time.

Cycle counting requires a huge effort and takes months to show results. Physical inventories give immediate results but require large efforts and cannot sustain accuracy.

A practical and effective approach to Inventory Record accuracy uses both the preventive and corrective methods of:

- Physical Inventories
- Cycle Counting
- Error Reduction
- Transaction Reduction

Error Correction

Figure 13 shows a typical IRA over time when physical inventory is employed by itself (red line), when cycle counting is used alone (green line) and when the two are used together (purple line). As discussed previously, the physical inventory gives good and immediate results but cannot sustain accuracy. Cycle Counting eventually provides excellent and sustainable results but it takes many months.

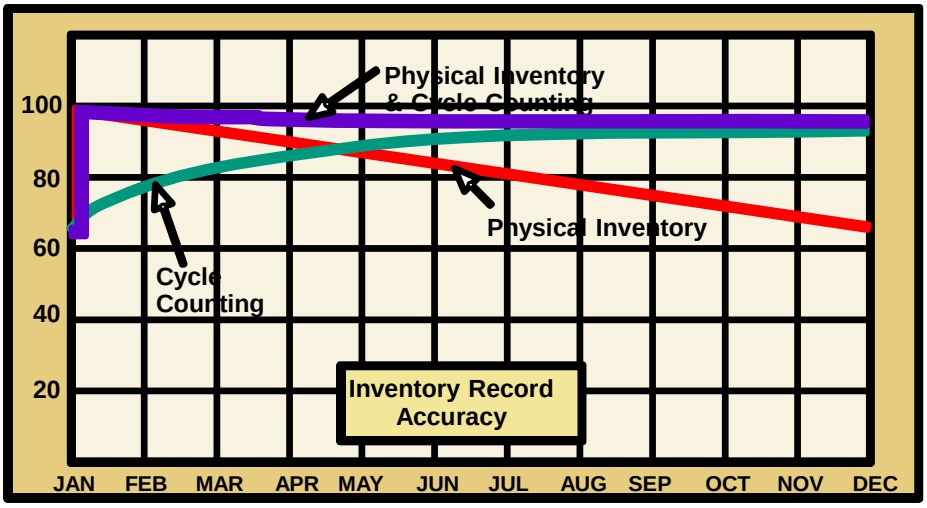


Figure 11 combining cycle counting & Physical Inventory

The combination (purple line) is usually the best approach. The physical inventory immediately raises IRA. Cycle counting then sustains it at a high level. The precise curve for an actual situation might differ from figure 13. It depends upon:

- Physical Inventory Effectiveness
- Number of Cycle Counts
- Error Creation Rate
- Number of SKUs

Figure 14 shows the effect of cycle count rate. In this example 200 counts/week results in an IRA of 94%. A rate of 100 counts/week peaks at about 84% and in both cases it requires almost two years to reach the maximum accuracy. A rate of 400 counts/week gets a 98% accuracy after one year.

"An ounce of prevention is worth a pound of cure."

-Benjamin Franklin

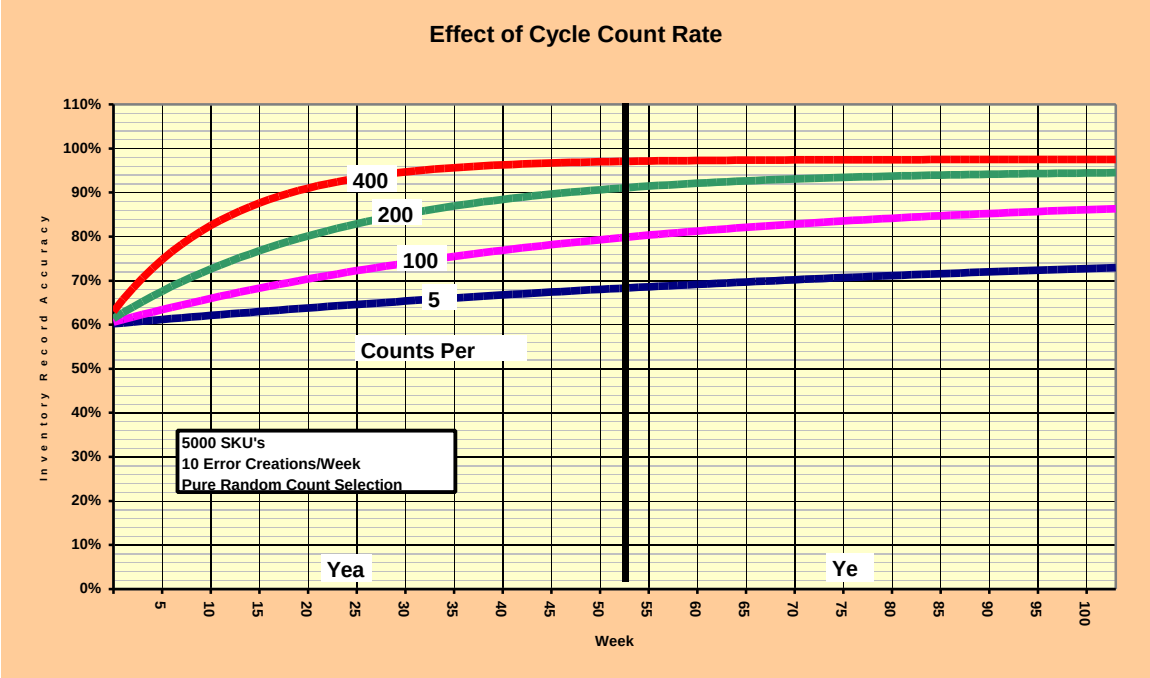


Figure 12 Effect of Cycle Count Rate

Error Prevention

The rate at which new errors are crated and introduced to the inventory system also affects both the maximum achievable accuracy and the time required to approach this level of accuracy. Figure 15 shows a typical system and how error creation affects it.

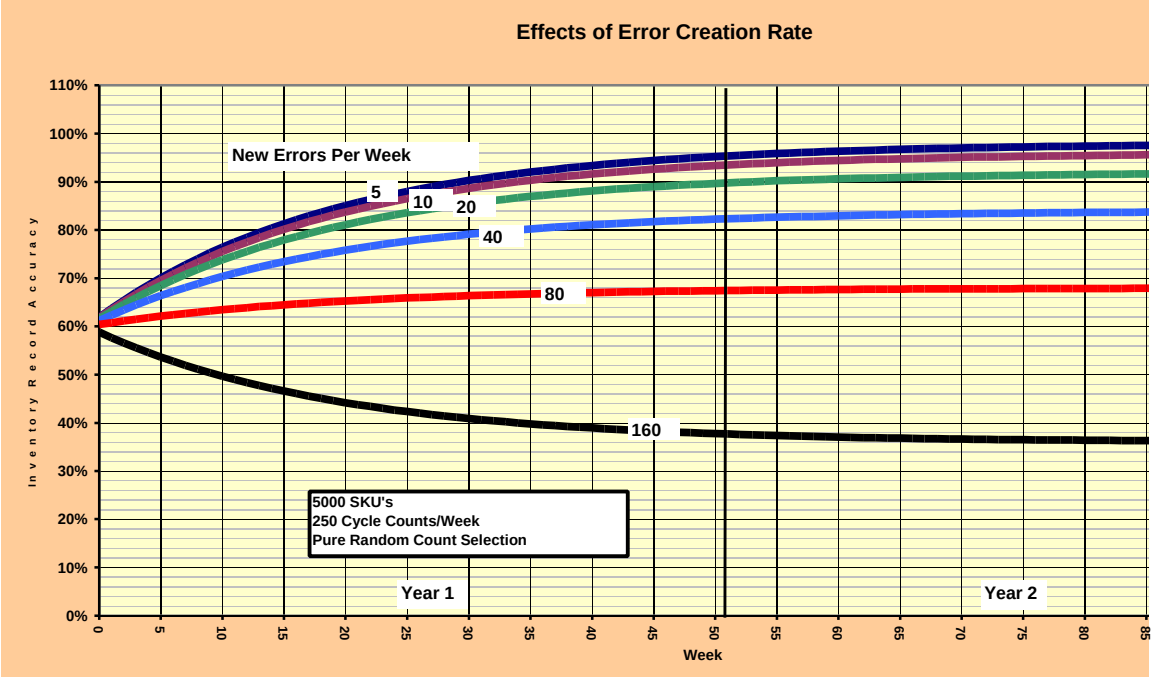


Figure 13 Effect of Error Creation Rate

With an error rate of 40 errors/week, the maximum obtainable IRA is about 84%. with an error creation rate of 10 errors/week the IRA is 96% and accuracy increases much faster in the early weeks.

Designing & Implementing the IRA System

- **Estimate Cost of Current Situation**
- **Design Program**
  - Plan Selection Strategy
  - Estimate Required Count Rate
  - Calculate Staffing
- **Plan Training**
- **Develop Implementation Schedule**

The details of these tasks are part of our training program on Cycle Counting & Inventory Record Accuracy. Future articles will also provide additional detail.