

Inventory control & Improving Record Accuracy in Production

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Abstract - This Paper explores the systematic variation in inventory record inaccuracy (IRI) within stores. Most Traditional inventory models, do not account for the existence of IRI and those that do treat record inaccuracy as random. Examining inventory records from stores, we found a significant amount of them to be inaccurate. The recorded inventory quantity of an item fails to match the quantity found in the store. This paper identifies factors associated with this inaccuracy that are stock keeping unit (SKU) and store-specific. SKU-specific factors which include item cost, selling quantity, and method of distribution account for the observed variation in IRI within stores. Store-specific factors which include the density and variety of inventory observed at each store account for the variation in IRI across stores. **Keywords** - Inventory Record inaccuracy, Traditional inventory models, Stock keeping unit.

I. Introduction

One of the great concerns to any organization is their inventory and distribution policies to ensure customer satisfaction, however, it's agreed that inventory records measurement is important performance indicator of inventory control, distribution center, and customer service level, and it's also important for effective and efficient supply chain.

Inventory accuracy means that the perpetual records shows the same quantity as it is actually in stock (on-hand inventory), since it's nearly impossible to keep 100% accurate data all the time, a tolerance percentage is considered based on materials being measured.[1]

In practice, keeping inventory is very important to satisfy customer needs, however, planning for keeping the right amount and type of inventory is strongly dependent on accurate inventory data whatever a manufacturing system an organization adopts (Lean or MRP), inventory inaccuracies can and will lead to profit losses, customer dissatisfaction, and competitiveness disadvantages specially for big organizations.

This research gives an overview about Inventory Record Accuracy (IRA), its importance, related articles, measurements, and some tools and approaches to achieve and maintain high record accuracy[2].

II. The importance of record accuracy

Accurate data is very valuable asset for any organization, it's as important as materials and considered as the core of any organization planning and scheduling of many areas like **Causes of Inventory inaccuracy:**

Financial department need it to issue the financial statement of the company.

Marketing and sales to help recognizing what customer needs the most and plan accordingly.

New product planning to know when to introduce the new product where the old one is fully depleted.

Procurement planning to know how much to order based on how much is really on hand.

Production planning where it helps company to utilize its resources better by minimizing shortages.[3]

There are several reasons to have inaccuracies, they might be:

- Incorrectly manually adjusted by employees.
- Products can be stolen
- Damaged or spoiled products, when not recorded as such,
- Returned products that occasionally not accounted
- Store can receive mis-shipments from the distribution center
- Cashier error

III. Tolerances and measures of accuracy

Accurate records was proven as an essential part of the manufacturing process, wrong records means wrong decisions that will affect manufacturers, suppliers, and customers.

For any manufacturing process there are four basic questions have to be answered:

1. What are we going to make?
2. What does it take to make it?
3. What do we have?
4. What do we have to get, and when?

The last two questions directly related to inventory accuracy, however, in practice answering question three is not so easy and we can't always have exact count value of materials exists, that's why we need to assign tolerance to these items, in other words, if the count of an item falls in the range pre-assigned to it, it's considered as accurate.

There are many techniques to measure record accuracy based on the definition of accuracy and units of measurement (dollar based or count based),[4] this depends on the organization interests, for explanation see the worked example below :-

Table 1. Worked Example of Inventory Accuracy

Miss	Hit	Tolerance (%)	Inventory record	Physical count	P/N
X		2 ±	100	94	1
	X	±5	100	95	2
	X	5 ±	100	96	3
X		2 ±	100	97	4
	X	2 ±	100	98	5
	X	2 ±	100	99	6
	X	0 ±	100	100	7
X		0 ±	100	101	8
	X	5 ±	100	102	9
X		2 ±	100	103	10
	X	5 ±	100	104	11
	X	5 ±	100	105	12
X		0 ±	100	106	13
			1300	1300	Total

The example shows inventory of 13 different parts compared with its physical count, if tolerance was ignored, just one item out of 13 is matched to its on-hand inventory that means the accuracy is approximately 8% in this situation, however if to consider tolerance in this example,

8 out of 13 is considered as accurate with an average accuracy of 62% approximately, the following formula is used to measure accuracy:

$$\text{Record accuracy} = \frac{\text{Number of accurate items}}{\text{Total items}} * 100$$

Another measure of accuracy is related to dollar value of discrepancies between record and on-hand inventory and calculate value of discrepancy by the formula:

$$\text{Value discrepancy} = \text{Unit stock value} * (\text{Quantity on record} - \text{Quantity in stock})$$

While production and inventory personnel interested in count discrepancies, financial managers also have interests in accuracy as dollar value of discrepancy as shown below

:-

Table 2. Inventory accuracy record

P/N	Physical count	Inventory record	Tolerance (%)	Discrepancy %	Unit Cost (\$)	Discrepancy value
1	94	100	± 2	-6	10	-64
2	95	100	±5	-5	2	-11
3	96	100	± 5	-4	6	-25
4	97	100	± 2	-3	13	-40
5	98	100	± 2	-2	8	-16
6	99	100	± 2	-1	14	-14
7	100	100	± 0	0	7	0
8	101	100	± 0	1	17	17
9	102	100	± 5	2	16	31
10	103	100	± 2	3	6	17
11	104	100	± 5	4	13	50
12	105	100	± 5	5	9	43
13	106	100	± 0	6	2	11
Total	1300	1300		8/13=0.615		0

The example shows a match between physical and record dollarized value, this would please financial managers, but

for production managers it completely different, therefore, record accuracy measurement depends on interest of the company and its target of accuracy.[5]

While it's not worth spending a lot of time setting tolerance rather than fixing inaccuracies problems, organizations of high record accuracy set tolerances depending on:

- Usage
- Dollar value
- Lead time
- Level in the bill of material
- Criticality
- Method of handling
- Combinations of the above

Table 3. Tolerance Percentage when using ABC

Class	Tolerance (%)	Dollar value
A	1	80
B	2	15
C	5	5

This method has some limitations since it ignores the other considerations of tolerance like lead time, also if a part in a lower class has a low price but very high usage it may jump to higher classes.

A. Methods for improving accuracy

Several methods is adopted to improve record accuracy and eliminate errors occurred during transactions, there are methods that focused on counting records and other methods that focused on process improvement, a combination of these methods was also conducted.[6]

B. Cycle counting

Cycle counting-usually called perpetual inventory checking- is a proven method to monitor and check inventory accuracy on a continual basis, where a small

number of items are physically counted, daily, on a random basis. The physical count is compared to the inventory record.[7] When necessary, the records are corrected.

Several methods are available to implement cycle counting, for example they may depend on:

- **Aisle to Aisle Counting**

This is simple to organize, as counters start at one end of the stores and gradually work along to the other, this method requires large efforts and resources to be implemented.

- **ABC Cycle Counting**

This method uses Pareto principle where items are classified based on their turnover value into three classes (sometimes four, the fourth stands for non-movers), the A class will be cycle counted more often than other classes, A class is normally the first 10%, B class is the next 20%, C class is the remaining 70%, these value are not the same for every organization, an example below shows how to implement ABC analysis.[8]

Table 4. The summary of ABC analysis

<u>Classification</u>	<u>Percentage of items</u>	<u>Percentage of value</u>	<u>Value per class</u>
A	10.0	66.8	4764
B	20.0	23.2	1655
C	70.0	10.0	712
<u>Total</u>	100.0	100	7131

Although this method is widely accepted, it has some flaws, for instance, if the number of items increased, more counters and resources are needed to complete the count, it also ignore the impact of other factors on materials like lead time and focuses only on financial impact.[9]

Using of statistical process control (SPC) also suggested to monitor accuracy alternating or accompany cycle counting technique, the application has been studied of statistical process control technique on large departments.

C. Three phase approach to inventory record accuracy

Each phase contain several tasks that if implanted correctly, an accuracy of 95% or better is granted, **Phase I** (design and preparation) is considered the most important phase since other phases depends on it, this phase usually takes 6-12 weeks to complete.

In (**Phase II**) records balance is established, on hand inventory is calibrated using any technique as long as it's done accurately and quickly, this phase should take 3 weeks maximum.

The last phase (**phase III**) is ongoing process of measuring records accuracy using cycle counting where the source of problems is found and corrected to maintain high accuracy as long as process integration is achieved.

- Phase I - Design and Preparation**
 1. Design Inventorying Process
 - A. Stock vs Work-in-Process
 - B. Layout
 - C. Transactions
 2. Measure Starting Point
 3. Provide Tools
 - A. People
 - B. Systems
 - C. Physical
 4. Finalize Policies and Procedures
 5. Train Personnel
 6. Education
 7. Assign Responsibility
 8. Implement New Policies and Procedures
- Phase II - Develop Initial Balances**
 9. Develop Initial Balances
- Phase III - Cycle Counting**
 10. Control Group Cycle Counting
 11. Ongoing Cycle Counting Program
 - A. Select Method
 - B. Assign Responsibilities
 - C. Correct Error Causes

Figure 1. Phases of Inventory accuracy

Some of the quality tools used to analyze and find causes of record inaccuracies is the fish-bone diagram and Pareto chart, other problem solving techniques can be used to solve accuracy problems like brainstorming.

D. Accuracy through information technology

The basic requirement of any inventory control system to have accurate records is:

- Multi location options on the stock record
- allocation options
- transfers between locations
- ABC classification
- Real-time operation.

Information technology techniques has many applications in manufacturing to facilitate the processes of transactions and recording.

- **Bar coding**

It's a common technique used to label products and trace it using bar coding system, the system has many languages available according to industry standards, implementing barcoding technique can be cheap and fast way of recording accurately.

- **Weigh counting**

It's a convenient way of counting inventory that can be implemented in any stage of manufacturing process, however care should be taken especially from human manipulation that will affect data accuracy.

- **Monitoring manufacturing work in progress by automatic recording devices**

It is used in manufacturing in stages that has continuous flow of materials, it can detect number of product,

operations, and products produced in the equipment between processes to give precise measures.

III. Conclusion

Inventory record accuracy problems can lead to severe losses in supply chain and impact the competitive position of organizations, IRA is an essential factor for adopting any manufacturing systems, managers are under great pressure for optimizing their inventory and keep high level of accuracy and data integrity.

Although measuring inventory accuracy depends on company' interests, care should be taken with financial measurements of accuracy since they can give wrong indication of records accuracy if implemented separately.

Among the strategies used to improve record accuracy the cycle counting is proved to be A powerful technique, it enables more frequent auditing of records and detect inaccuracies on a regular basis, identifying causes of discrepancies and take actions to ensure continuous improvement of records.

Another approach of responding to inaccuracies is to take preventive actions, that is ensuring process integrity and robustness, implementing the information technology can also improve accuracy significantly and contribute to supply chain improvement.

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