TABLE 6.1: Annual Physical versus Cycle Counting

Annual Physical	Cycle Counting
* Stopped and lost production.	* Eliminates the loss of productive time.
* Week-end work at premium cost.	* Done during normal working hours by one person at low costs.
* Counted by inexperienced personnel without adequate product knowledge thus leading to: i. Items overlooked ii. Items counted twice iii. Errors in counting iv. Identification Errors	* Development of specialists who become efficient in obtaining good counts and good product knowledge.
* Inability to trace causes of error. Errors could be one year old, i.e. introduced since the last annual count.	* Timely detection and correction of conditions causing errors. Most errors are at most 2 to 3 months old, i.e. since they were last cycle counted.
* Large number of errors since last count.	* Few errors which allow for focusing on problem areas.
* Time constraint and haste	* Counting is done according to a pre-scheduled programme, where time is not a constraint.
* Second counts are needed to to verify first person's count.	* No second count is needed.
* Does not assist in the continuous monitoring of accuracy.	* High level of inventory accuracy with continuous monitoring of accuracy.

* Extra resources needed such as hired forklifts, scales and scaffolding.	* Uses the present Materials Handling resources.
* Once-a-year validation of assets	* Correct statement of assets throughout the year.

6.2 CYCLE COUNTING OBJECTIVES

The objectives of this ongoing auditing procedure are to: (1)(8)

1. Count and correct the inventory records of all stocked items on a continuous basis.

2. Develop quantitative measures indicating whether or not progress is being made in eliminating the errors.

3. Focus attention on identifying and solving the cause of errors.

4. Rigorously control and maintain a 98% level of inventory accuracy.

Procedures for counting, reconciling inventory records in error and eliminating the causes of errors, are discussed in detail in later chapters.

6.3 CYCLE COUNTING PHASES

The way to conduct the entire cycle counting programme leading to the point where a 98% inventory accuracy is achieved, varies from management to management. Management may decide to use an ABC count, a 100% part count or a simpler control group count throughout the entire programme life-span. The method described below is the one found in the literature, (1)&(8), and consists of three basic phases:

1. **Initial Phase**

   - Select a representative group of part numbers to be used as a control group (approximately 50 to 100 part numbers). This has the primary objective of identification and elimination of the causes of error. The part numbers should be carefully selected, so that they are likely to lead to significant problems, perhaps because of their high transaction volume.

   - Cycle count the control group weekly.

   - Record the accuracy obtained by comparing the count with the actual records.

   - Reconcile all inaccurate records weekly to determine the errors or problems contributing to inventory inaccuracies.

   - Continue the control group audit until a 98% record accuracy is achieved for four consecutive weeks.

   - Select a new control group and bring it up to the 98% level of accuracy.

2. **Intermediate Phase**

- Once the control group has reached a 98% or a higher level of stock accuracy, start cycle counting either by counting all stock part numbers or by means of an ABC analysis. This phase is designed to convince the auditors that the records are good enough to eliminate the annual physical inventory count.

- Select and count parts such that they will be counted at least three times per year.

- Continue counting, identifying and correcting all sources of error until the desired stock accuracy targets have been achieved and maintained.

3. **Mature Phase**

- Once again select a representative group (50 to 100 part numbers) to be used as the basis of the count. This control group is now used as a control approach rather than the diagnostic tool of the Initial Phase.

- This group should be counted once a month unless its stock accuracy drops below the 98% level. It should then be counted weekly until the 98% accuracy is restored.

- The control group part numbers should be changed at least three times per year.

There appears to be no real distinct occurrence that will tell a manager when to switch over from the Intermediate phase to the Mature phase or from the Initial to the Intermediate phase. One could start a cycle counting programme with the characteristics common to the first two phases. For example the control group count, the ABC and the area group counts could all be happening simultaneously.

The purpose of the two phases is mainly to eliminate all causes of error. The third or Mature phase is simply a way of monitoring the average stock accuracy, once it is felt that a 98% accuracy has been maintained for a long enough period.

At Sulzer Brothers the steady state of our maturing cycle-count programme is a trend towards less counts per annum for each distinct area or group.

6.4 OTHER USES FOR CYCLE COUNTING

The only use for cycle counting mentioned so far, was the one for the monitoring of on-hand inventory. Since cycle counting is the only effective way of achieving the necessary levels of accuracy in vital manufacturing records, this technique can be applied to other uses.

Plossl(1) defines cycle counting as "*the* **periodic** *checking of actual data against corresponding record data on* **all** *important manufacturing records for a sample of items, to verify record accuracy and detect causes of errors*". Table 6.2 demonstrates the types of individuals who could cycle count various records as a by-product of their daily activities.

The cycle counting technique when used for records as listed in table 6.2, should follow the same procedures as described for the inventory accuracy situation and therefore the following basic principles of cycle counting must be applicable:

- Carefully select a small sample which is known to lead to potential problems.

- Make a physical count and compare it to the records.

- Double check the physical count when a significant difference is discovered.

- Trace the basic cause of errors and eliminate them.

TABLE 6.2: Who can count which records?,(1).

INVENTORY BALANCES
- Storekeepers
- Auditors

BILLS OF MATERIALS (B.O.M.)
- Storekeepers (by means of pick lists)
- Inspectors
- Assemblers (by checking pick lists against B.O.M.)
- Testers

OPEN PURCHASE ORDERS
- Buyers
- Accountants

OPEN MANUFACTURING ORDERS
- Working planners
- Set-up people
- Floor inspectors

CUSTOMER ORDERS
- Order Entry people
- Sales people

COST DATA
- Cost accountants
- Planning people

6.4.1 CYCLE COUNTING FOR OPEN MANUFACTURING ORDERS

The application of cycle counting techniques to Work in Progress (WIP), is very important since WIP is just another type of inventory like raw materials and finished goods.

This section presents a summary from an article written by Steve Meyerowitz on the subject of "WIP Cycle Counting", (9), in a MRP environment.

The logic behind MRP must briefly be explained in order to appreciate the requirement for high accuracies in Work In Progress.

The MRP logic can be summarised as follows:

- Calculate Gross requirements.
- Net Gross requirements against stock (here high inventory accuracies are essential).
- Determine planned order quantities, due dates and start dates in order to cover any shortages not met by the netting logic.

MRP logic on its own, does not guarantee that a works order will meet its due date and so, cycle counting helps to ensure that the works order due date is met, by continually monitoring the progress of WIP. Cycle counting will show when the works order is falling behind schedule, thus enabling corrective actions to be taken.

To satisfy MRP and to obtain the maximum control over the production cycle, the following requirements must be met:

1. Accurate inventory data (98%), so that accurate net requirements may be planned.

2. Existence - accurate information about which works orders are in progress for MRP netting purposes.

3. Location - Accurate information about the status of each works order, that is, where the works order is in its process or routing so that it can be compared with the schedule.

Point 1 is addressed by the normal stock accuracy programme, but points 2 and 3 need a different WIP accuracy programme. This WIP cycle counting programme can be done using any one of the following approaches:

1. **ABC Analysis of Part Numbers** - This technique can in turn be done by adopting any one of the following three alternatives based on value:

   a. WIP value - correct value but changing continuously.

   b. Finished item value - greater than WIP value but constant.

   c. Raw Material value - less than WIP value but constant.

2. **ABC Analysis by Work Centre** - On a daily basis several work centres would be selected for counting and a list of all works orders in these work centres obtained and verified for existence or correct location and quantity.

3. **Sampling Theory** - This technique uses a statistical sample of the works orders or work centres to be counted.

Finally, like in other uses of cycle counting, the basic causes of errors must be traced and eliminated. Some of the most common error trends are:

   a. Works orders identified by the MRP system, that do not exist on the shop floor.

b. Works orders found on the shop floor, but not in the MRP system.

c. Works orders found on the shop floor, but which differ from the MRP system with respect to quantity and/or location.

Note that the above MRP system could also be any other tracking system, like PC & C (Production Control and Costing).

The author has recently suggested to Sulzer Management, the implementation of a work in progress cycle counting programme. The benefits were pointed out and accepted readily and the programme is expected to start at the beginning of October 1986. It is likely that cycle counting will be done by work centre either by the ABC technique or by the 100% works order count at each work centre.

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7.0 CYCLE COUNTING PROCEDURES

This chapter concentrates on the mechanics of cycle counting, that is, the different ways of approaching the counting, the various parameters to be set, the allocation of responsibility and the various cut-off techniques which enable the count to be done in the most efficient way.

7.1 CYCLE COUNTING SELECTION

A cycle count programme must provide a system for continuous physical counting of the stocked on-hand inventory throughout the year. There are several ways in which this can be achieved (8), namely:

- ABC analysis counting
- Geographical or Block counting
- Random selection counting
- Transaction volume counting
- Schedule receipt date counting

The ABC and the Geographic counting are the most commonly used methods. The ABC technique will be presented from the article written by Cantwell (3), while the Geographic method will be described exactly as it is done in Sulzer's environment.

7.1.1 THE ABC ANALYSIS TECHNIQUE

The ABC analysis works on the Pareto Principle, which states that items belonging to the 'A' class are usually responsible for 80% of the stock value although they only make up 20% of the total number of parts. The following steps outline the process leading to ABC cycle counting (3):

1. Obtain a printout of the ABC analysis report in a descending value sequence. The value amounts are determined by multiplying the standard cost by the item's annual usage.

2. Determine the cut-off points by value for the 'A' and the 'B' classes. This discussion is based more on managerial judgement than on mathematics. A set of standard rules recommended by the American Management Association are as follows:

TABLE 7.1: Standard Rules for ABC Classification, (3).

Value Class	Percentage of total number of items	Percentage of total value
A	10-15	60-70
B	10-15	20-30
C	70-80	0-20

3. Determine the number of counts needed to run an effective count programme, for example, 'A' items are counted every two months, 'B' items every four and 'C' items only once a year.

The greatest problem associated with an ABC analysis is the question of whether the unit costs are accurate or not. If unit costs are incorrect, an item can be positioned in the incorrect ABC class. Two common aspects of the problem are:

1. 500 screws with unit price captured as R60 each, instead of R0,60, will position this lot in the 'A' class with a R30 000 value, whereas its correct place is in the 'C' class with a value of R30.

2. If an item's unit of measure is "each", at say R30/unit, and then an engineering change alters its unit of measure to "mm", without changing the cost, say to R0,08/mm, then the total value of the on-hand stock, say 2000mm, becomes 2000*30=R60000 instead of 2000*0.08=R160.

7.1.2 THE GEOGRAPHICAL COUNTING METHOD

This cycle counting method, also called area-block counting, is simpler than the ABC analysis method. The concept is to count all parts by dividing the various classes of stock into geographical areas.

This can be done if the warehouse is intelligently divided into various storage areas such as castings, bar material, accessories, finished goods, etc.

This method was used by the author in the implementation of the cycle counting programme and it ensures that all stocked items are covered by the programme. The warehouse plan view shown in figures 8.1 and 8.2 in chapter 8, shows that not only are the finished goods kept separately from the accessories or castings group, but they are in turn divided into product groups.

Therefore each product group, because it is kept in a zone of its own, becomes a suitable area to form part of the cycle counting programme. By auditing the area, the stock accuracy obtained, simultaneously reflects the accuracy of the area and the accuracy of the particular product group or raw material class, such as hollow bar and solid bar. This gives important managerial information.

The entire stock was neatly divided into 14 areas, which together with the control group formed part of the cycle count programme as shown in figure 9.1 in chapter 9.

The frequency of count for each area could then be determined by either the stock value of that area, or by the number of stock turns, which is high for popular product ranges, originating more transactions and consequently a higher number of errors.

The entire stock, with the exception of accessories, was counted between three and four times during the first year of this programme. Another distinct advantage of counting by zoned geographical areas, is that it helps in the reconciliation and the finding of the causes of errors, because the items belonging to a particular pump product are not spread out throughout the warehouse.

7.1.3 RANDOM SELECTION COUNTING

As the name implies this method consists of obtaining a list of stock locations or items from random computer selections.

One can either obtain random selections from the entire stores or alternatively from a smaller specific area within the stores. This method can be useful as a fast means of getting an average figure, but on the other hand it may not pick up all the errors living in the system.

7.1.4 TRANSACTION VOLUME COUNTING

This technique is based on the assumption that the rate of error increases as the transaction volume of a particular product gets larger. Again a computer program must be used to retrieve the items with the largest transaction volumes over a specified period. Furthermore, the number of transactions and transaction types to be retrieved must also be determined. Any special transaction types like unplanned issues or receipts should always be counted irrespective of volume, since these are usually more prone to errors.

One shortcoming of this method is once again the possibility of not selecting items which could be in error, despite their very low transaction volumes.

7.1.5 SCHEDULE RECEIPT DATE COUNTING

The selection criteria behind this method of cycle counting, is to retrieve those items which show a "receipt-to-stores" date older than a certain selected date. This method allows for fast counting because all recently received items are excluded. It assumes that the recent receipts have a lesser chance of being in error than the older receipts.

7.2 ALLOCATION OF RESPONSIBILITY

Cycle counting auditing should always be done by someone outside the Materials' Handling department. This kind of arrangement carries a much higher credibility when inventory accuracies are reported to management, than in the case when the audit is done by those accountable for the stock.

The qualifications for a good cycle counting auditor, involve far more than knowing how to count. It includes proper use of counting scales, nesting containers, geometric racking, ability to find all the items and above all, the ability to identify all items properly, which can only be done by someone having an in-depth product knowledge (1).

The auditor is also responsible for measuring and publishing the stock accuracies to management, preferably by presenting then by means of graphs and bar charts. A typical example would be a bar chart with percentage accuracy against time.

The responsibility of the Materials Handling Manager, include the supervising of the comprehensive reconciliation of stock errors, the training of his reconcilers, the setting up of a cycle count programme and the implementation of procedures to eliminate all causes of errors.

Another very important responsibility is to maintain adjustments of inventory within an allowable tolerance. Furthermore, he must have a logical explanation if adjustments to stock exceed pre-determined tolerance levels, either in quantity or value (3). In the author's case all the stock adjustments exceeding plus or minus R5 000, must be submitted to the Plant Manager for approval and in some cases to the Financial Department Manager.

7.3 ERROR TOLERANCE

Error tolerance is a function of the nature of an item, together with the way it is cycle counted and the cost of the item. A tolerance range must be set in order to make counting a practical, but reliable exercise.

For instance, when counting accessories like washers or nuts, which are stored in hundreds, or even thousands, the quantity physically found may not tie up 100% with that item's quantity on record. A range expressed in percentages, must be determined within which all errors are considered as "acceptable" as opposed to "significant".

The following table shows the percentage tolerance ranges, which must be applied for each typical category of items, or methods of counting.

TABLE 7.2: Typical Error Tolerance Ranges,(8) & (1).

* Expensive Items		0%	
* Line stoppers		0%	
* Hand counted		0%	
* Weigh counted	+ or -	3%	
* Floor stocks	+ or -	5%	
* Two-bin stocks	+ or -	5%	
* Bag stocks	+ or -	5%	
* Unit of measure conversion	+ or -	5%	
* Accessories	+ or -	10%	(This is Sulzer's accepted error tolerance and not an industry norm)

As Plossl(1) stated "*The concept of significant errors is probably one of the most important in cycle counting. Those companies which have achieved higher levels of accuracy usually tighten up their tolerance ranges in order to continue to find significant errors and eliminate their cause*"

7.4 CUT-OFF CONTROL TECHNIQUES

Cut-off techniques enable a cycle count to be carried over a stock area as if the entire area content had been "frozen". The stock condition must be "frozen", so that no pickings or transactions take place during the count.

In practice, it is difficult to control paperwork in a manner that permits immediate update of stock records. There is always a delay between time of picking or packing and transaction processing. The auditor may find that during the counting time, his physical check differs from the record on his cycle count list. At this point he is not aware whether the error is genuine or simply due to a late transaction for an item picked or packed just before the start of the count.

Various cut-off methods can be adopted to get around this problem, such as:

1. Count Transactions

The transaction documents should be counted, separating those that relate to movements made before the physical check, from those afterwards. This way the auditor can establish what the proper records were before the count started(1). A major disadvantage is that finding these documents can be a difficult task for a busy workplace.

2. Timing Count

Set up procedures so that all transactions are processed before the end of the day, so that a cycle count can take place early the next morning(1).

The disadvantage with this method is that all packing and picking must stop for some time before the end of the day, to allow for their transactions to be captured. This means that cycle counting is interfering with the normal production time, which should not be allowed to happen.

3. Freeze Activity

All the activity on the items being cycle counted must be frozen so that no physical movements will be made between the time the count is taken and the record balance is verified. Activity will be frozen until all the transactions "in the pipeline" have had time to be processed(1).

The disadvantage here is the fact that it is almost impossible to freeze picking on stock which might be urgently needed at Assembly or Despatch. It is also difficult to educate and inform workers about which items are frozen and which ones are not.

4. Reprint Count List and Compare

This method is used at Sulzer and works on the fact that there is a strict lead time of four hours between the time of any physical stock movements and the time of their respective transactions.

Once the auditor has finished counting, with all the deviations carefully marked on the cycle count list, the list is reprinted four hours later. With these two lists, the auditor is now able to compare those records in error and separate the "genuine" errors from the "late transactions" errors. A similar cut-off control technique is used by Thompson (4) at the Norton Construction Products company in Georgia, U.S.A..

Any transaction not done within the four hour lead time, will give rise to an error and is considered as such. This method does not require that the items' activity be frozen as in method 3, or that production be stopped early in the afternoon as in 2. This method can be seen as a more sophisticated version of method 1.

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8.0 INTRODUCTION TO THE MATERIALS HANDLING DEPARTMENT

At this stage it becomes essential to throw some light on the Materials Handling unit. This will enable the reader to develop an understanding of its operational methods which will frequently be referred to in the forthcoming chapters.

The company's products are divided into two distinct groups, one being the *standard items*, which are order independent, and the other being *non-standard or contract items*, which are order dependent.

Being a leader in the field of hydraulic pumps, the company has a very high after sales customer service levels and is very strict on the product quality and work safety aspects. All these aspects dictate the way the Material is kept, handled and controlled. Special projects are constantly in progress to upgrade safety, quality and customer service.

There are 10 product lines in total, where two lines, one standard and one contract, account for approximately 80% of the total sales turnover. Before the cycle counting days, these two product lines had very low accuracy levels. This was attributed to the high transaction volumes for the standard line and to the complexity of operation involving those items belonging to a non-standard product line. The total stock consists of finished goods inventory, made up of components and sub-assemblies; raw material inventory, which is made up of castings, forgings and bar materials and a large stock of accessories. The accessory group makes up a large proportion of the total number of items in stock, although its value is low (80-20 rule being at work again).

The total number of part numbers is approximately 15 000, which emphasises the need for a computerised stock control system. Finished goods, accessories and bronze castings, because of their high commercial value,