5. Implement a cut-off control technique in order to allow for the delay between time of picking or packing and time of transaction processing.

6. Publish results and compare the actual accuracy to that of the previous count to calculate the time gap required until the next count.

Step 5 - Causes of Error: Detection and Elimination

1. Define an inventory record to be in error when:

   - the quantity found does not agree.

   - an item is found in the wrong location.

   - the identification of the item is incorrect.

2. Reconcile all errors thoroughly, making use of all the existing sources of information, like transaction history files, control books and any other form of information, even if it if found outside the Materials Handling department.

3. Determine from the reconciled errors which sources of errors are causing most harm to the inventory accuracy.

4. Establish what actions are needed to counteract these causes of error, so as to reduce their effect or to completely eliminate them. These actions could mean:

   - more efficient working procedures.

   - more personnel training.

   - better Materials Handling facilities.

- better Housekeeping.

Step 6 - Working Procedures

1. Improve on the existing working procedures in order to make them more efficient and error-proof. One way of doing it, is by means of "X-Y charting". This technique for developing procedures allows for:

   a. the detection of loose-ends in the working procedures.

   b. the detection of inefficient methods and redundant information.

   c. fast updating, thereby enabling your procedures to always be valid for training or referencing purposes.

Step 7 - Training

1. Use the latest set of working procedures to train any new employees.

2. Periodically, these procedures should be used to test how well employees adhere to their laid-down instructions.

3. Problems related to shortage of skills, such as Numeracy and Literacy, should be immediately related to the worker's job description requirements, and steps must be taken in order to decrease any gaps.

Step 8 - Projects and Housekeeping

1. Projects must be implemented whenever there are chances to improve the Material's Handling process. These may include the

rezoning of stock for faster pulling or the redesigning of racks for safer storage or more convenient picking.

2. Ongoing housekeeping exercises must be in place, so as to make the warehouse conductive to good inventory control. Orderliness and discipline must exist in all packing or picking methods. This speeds up the process of cycle counting and also maintains high safety and product quality levels.

The benefits enjoyed by Sulzer S.A.-Pump Division, from these efforts to bring about change, can be listed as follows:

1. An average inventory accuracy of 96%, as of the time this report was printed. In January 1986, the level was 92% and the target of 98% for December 1986 will certainly be achieved and maintained. These figures are all a long way from the 40% to 50% accuracy level, which prevailed in September 1984.

2. No more annual stocktakes took place since September 1984, which required approximately 60 people for four days. This resulted in an annual savings amounting to R36.000.

3. Service level to Spares Sales has increased significantly to a 99% level. This is a measure of the number of Customer Spares orders, which have been supplied ex-stock, without the embarrassment of an unexpected stockout.

4. Substantial improvements in productivity were made, specially with regards to the reduction in personnel, since no more expediting was needed. Consequently, the department's actual costs are running at R60.000 below budget.

5. Planners have for the first time trustworthy inventory figures making up strong pillars with which to support the forthcoming MRP system.

6. No longer any managerial turnover as a result of poor performances. Today there is a much better quality of life for all the Materials Handling employees, plus some carefully supervised career plans for key personnel.

The author is proud to say that the above achievements resulted mostly out of tapping the resourcefulness which exists in all of us, and not from heavy capital investments in the form of automation, for example.

The following comparisons between the author's experience and achievements to those found in the relevant literature, *highlights the universality* of the principles applied to obtain high inventory accuracies, plus the benefits arising from it.

1. The complete elimination of the traditional annual stocktake since the implementation of the cycle counting techniques has been recognised as one of the greatest cost saving opportunities by many companies like Sulzer Brothers S.A., FMC Corporation in Bowling Green, Kentucky - U.S.A., (3), and the Norton Construction Products in Gainesville, Georgia - U.S.A., (4).

2. All three companies mentioned above, have gone from very low inventory accuracies to 95%+ levels, within a period of two years after the implementation of cycle counting.

3. The eight steps to achieve high inventory accuracy described by the author, are in line with K.L. Thompson's sixteen steps, (4). The difference in the number of steps is due to Thompson's finer breakdown, although the same topics are covered. These steps cover points that are also mentioned by Plossl (1) & (2).

4. The remainder of the benefits enjoyed by Sulzer, like increased service levels, higher productivity levels, better quality of life, etc., have also been experienced by the Norton Construction Company (4), and have also been predicted by many other sources, such as Plossl (1) & (2), Cantwell (3) and IBM (7) & (8).

5. Finally, the author feels that in his literature survey, he found little emphasis placed on the *improvement of existing working procedures* , as a means to increase inventory accuracy. In his experience, this aspect constitutes the most important result arising from the detection of causes of errors.

15.0 APPENDICES

Appendix A: SLALOM Transaction Codes

Appendix B: Materials Handling Organisational Chart

Appendix C: Cycle Length Formula Derivation

Appendix D: 1985 Cycle Count Accuracy Chart

Appendix E: Materials Handling Projects Programme

15.1 APPENDIX A

SLALOM Transaction Codes

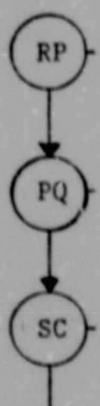
SLALOM TRANSACTION CODES

The following table shows the 17 inventory transaction codes, used for the many different types of stock movements. Because so much detail is imparted by these codes, an item's historical movements are easily interpreted, thus aiding the reconciliation process for records in error.

TABLE A.1 - SLALOM Transaction Codes,(8).

TRANSACTION	DESCRIPTION
IS	Miscellaneous Issue
RC	Miscellaneous Receipt
RP	Purchase Receipt
SA	Sales Issue
-SA	Credit Note
IP	Planned Issue
FR	Factory Return
RM	Manufacturing Receipt
IA	Inventory Adjustment
PH	Physical Adjustment
RQ	Reject by Quality Control
CQ	Cyclic QC Check Completed
PQ	Purchase QC Check Completed
MQ	Mfg. QC Check Completed
SC	Scrap
ST	Stock Transfer
-RP	Reversal of Purchase Receipt

All sorts of procedural rules exist for the correct use of each code or series of codes. For example, the complete procedure for processing an incoming Purchase Order (P/O) is as follows:



RP - P/O Receipt : done as soon as items arrive to acknowledge receipt only.

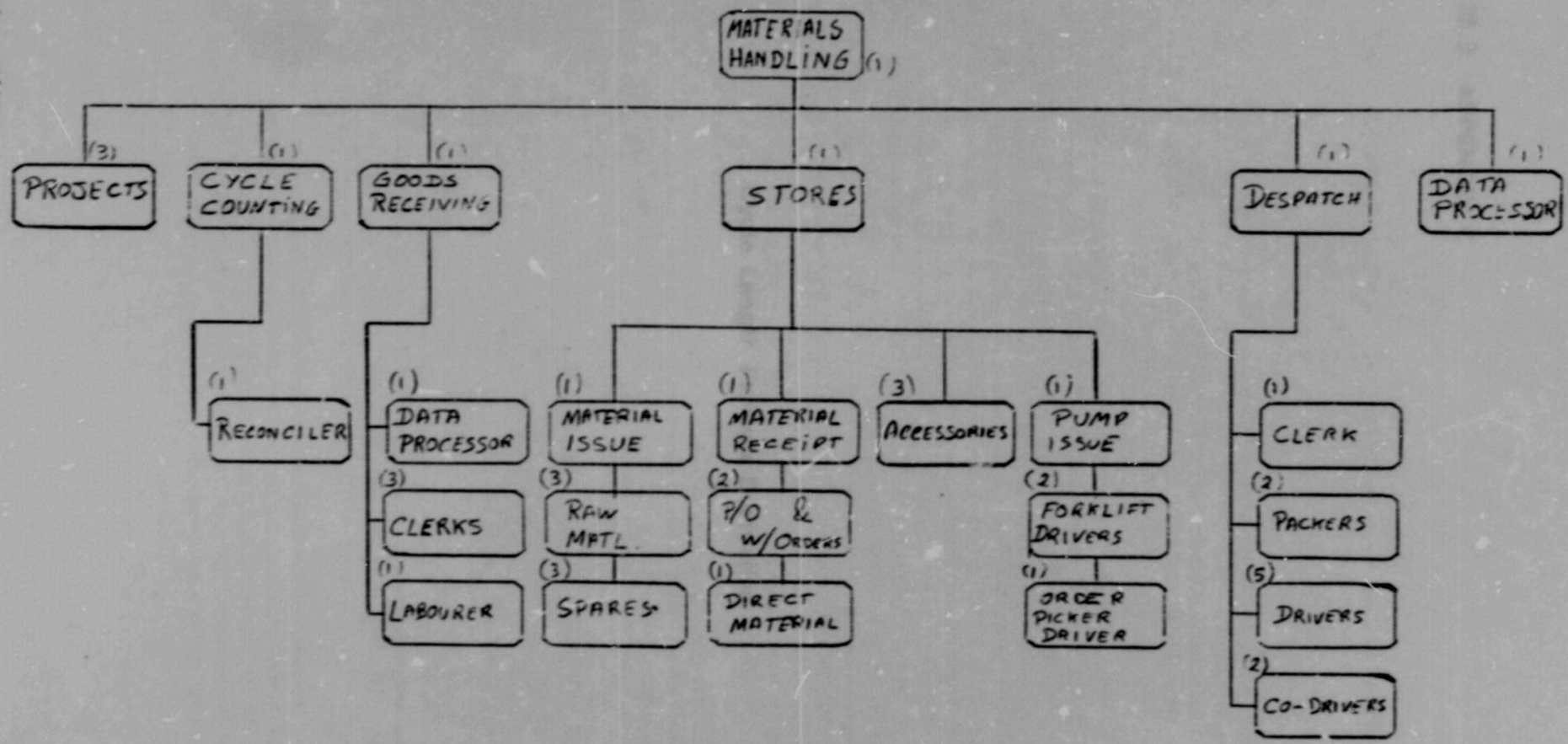
PQ - P/O Quality: after inspection by QC department. Check complete

SC - P/O Scrap : used if needed to scrap portion of the P/O when it fails to meet Sulzer's Quality standards.

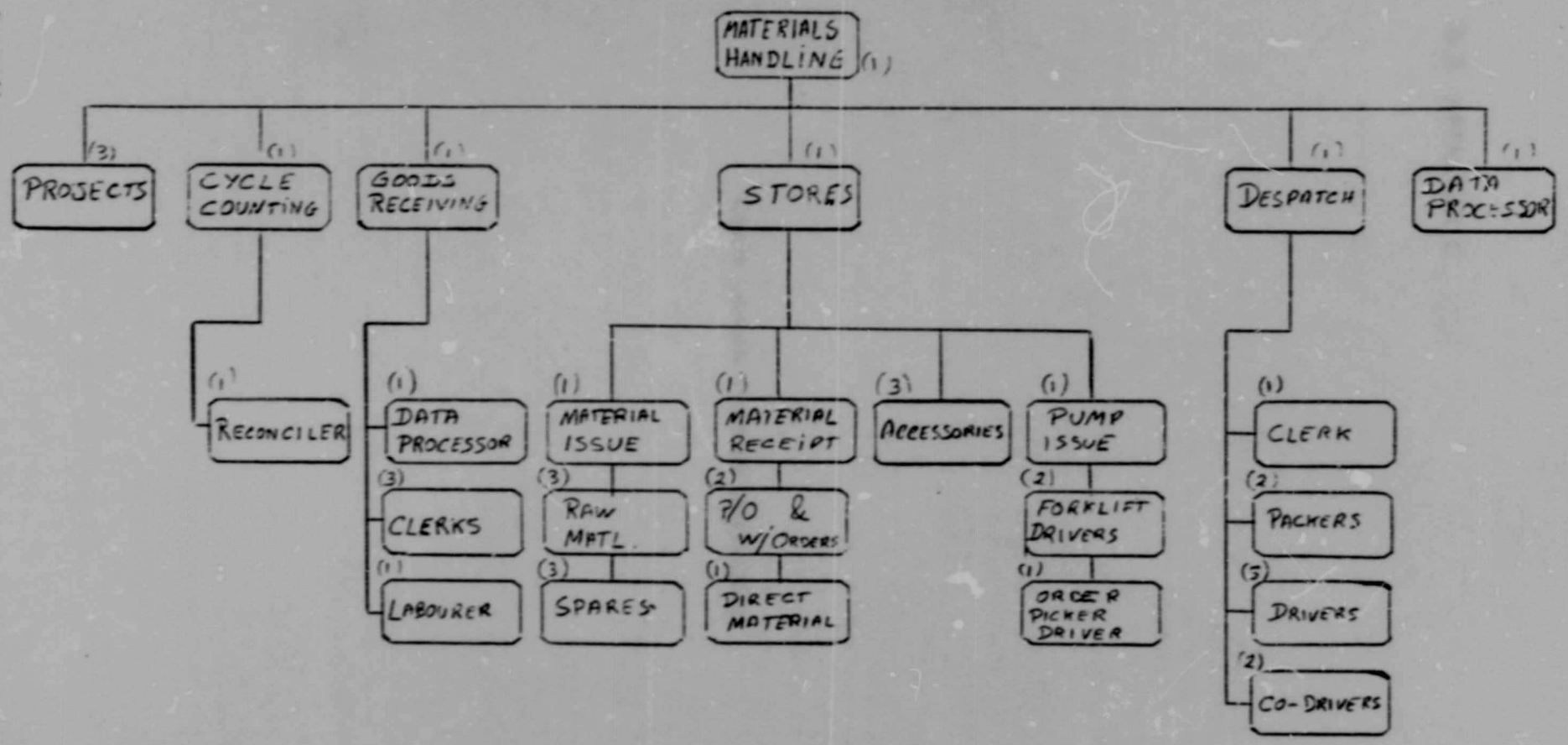
ST - Stock Transfer : Used to transfer all accepted stock from the inspection area to a final warehouse area.

15.2 APPENDIX B

Materials Handling Organisational Chart



TOTAL NUMBER = 43 PEOPLE



TOTAL NUMBER = 43 PEOPLE

15.3 APPENDIX C

Cycle Length Formula Derivation

Cycle Length Formula(5)

The following derivation is extracted from Neeley's article on "*A Framework for Cycle Counting*".

> The main idea is this—*no matter how bad the accuracy level of the system is at the outset, if we cycle count at a given rate and the probability of a part lapsing into variance remains constant, the accuracy level in the system rapidly approaches a constant value as we cycle count through the parts.*

We wish to derive the relationship between the probability of variance (Pr(variance)) of the system, the cycle counting period length (cycle time), and the constant accuracy value mentioned above. Specifically, we can imagine that each part in the system is either in a variance state or a no-variance state. Either the record balance-on-hand agrees with the actual or it does not. The probability of a part going from a no-variance state to the variance state is given by Pr(variance) of the system. Similarly, the probability of a part going from the variance state to the no-variance state would be given by the ratio of the number of cycle counts per time period divided by the total number of parts in the system or portion under consideration (we call this the cycle count ratio). For instance, let's suppose that we cycle count 200 parts out of 10,000 per week and that we have (as we always will) some undiscovered (and hence uncorrected) variances among the 10,000 parts. Then each week we cycle count we have 200 chances out of 10,000 of discovering, and hence correcting, a given variance.

Let us call the states in the system: State #1 (a variance condition exists for a given part); and State #2 (no variance exists for the given part). Then, with the considerations above, we could set up a table of probabilities of a part going from State #1 to State #2, State #2 to State #1, etc:

	State #1 (no variance)	State #2 (variance)
State #1 (no variance)	1-Pr(variance)	Pr(variance)
State #2 (variance)	Cycle Count Ratio	1-Cycle Count Ratio

The square (1,1) of the table corresponds to the probability of a part in a no-variance state remaining in a no-variance state, which is 1 – Pr(variance). Square (2,1) of the table corresponds to the probability of a part in a variance state being corrected to a no-variance state by a cycle count, which is the cycle count ratio. Squares (1,2) and (2,2) follow in the same way.

The situation we have been discussing (i.e., successive cycle counting through a given population of parts) is a very simple example of what is called in mathematics a *Markov* chain. It can be shown (see any standard text on business mathematics) that the constant value of system accuracy, alluded to above as the value approached in successive cycle counts, is P, where

P = the steady state probability of being in State #1

$$= \frac{\text{Probability of going from State \#2 to State \#1}}{\text{Probability of going from State \#1 to State \#2} + \text{Probability of going from State \#2 to State \#1}}$$

From our table above we can fill in all of these probabilities.

Filling in the probabilities from the table above, we see that

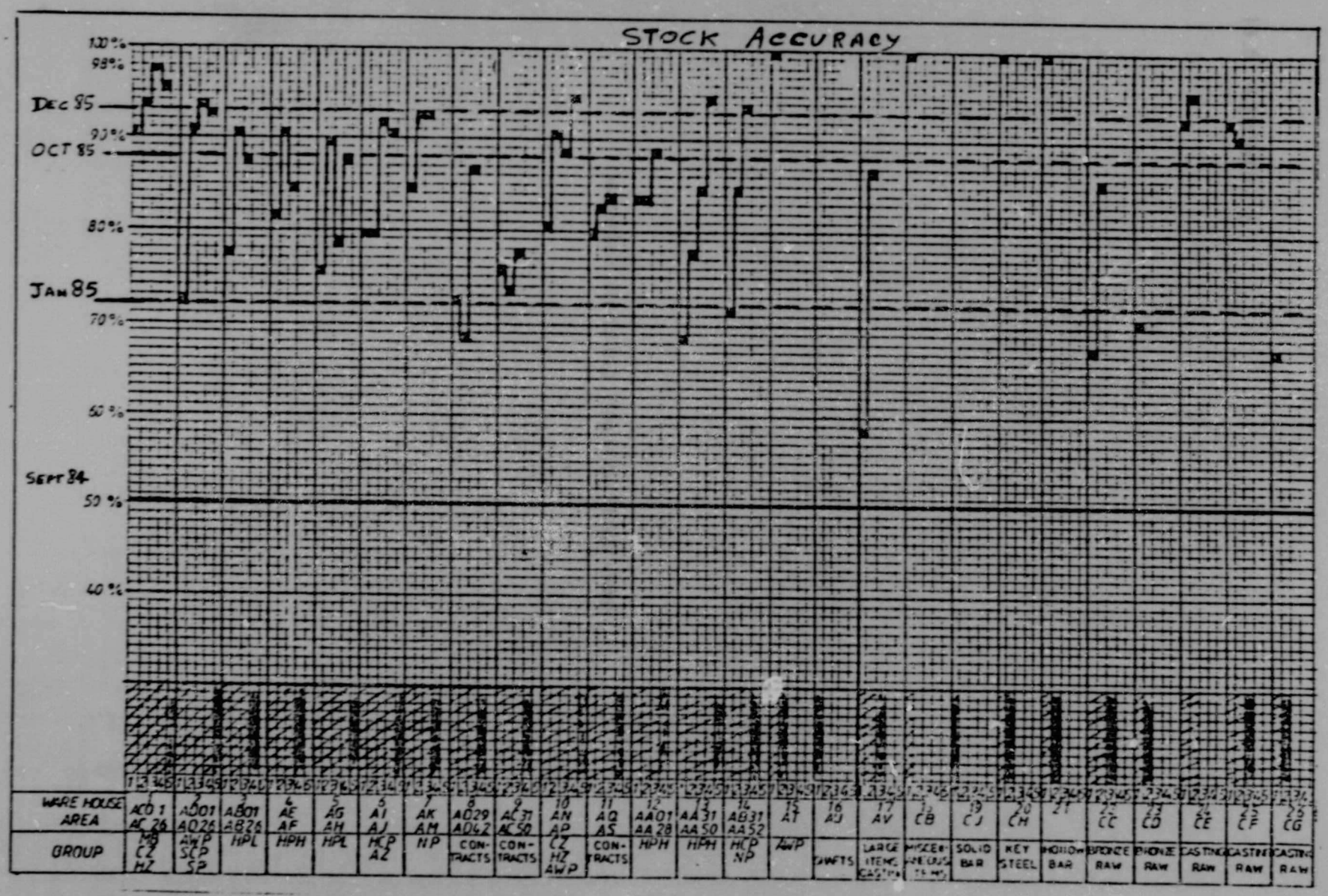
$$P = \frac{\text{Cycle Count Ratio}}{\text{Pr(variance)} + \text{Cycle Count Ratio}}$$

Solving for the Cycle Count Ratio, *and remembering that Cycle Count Ratio = 1/cycle length.* We have:

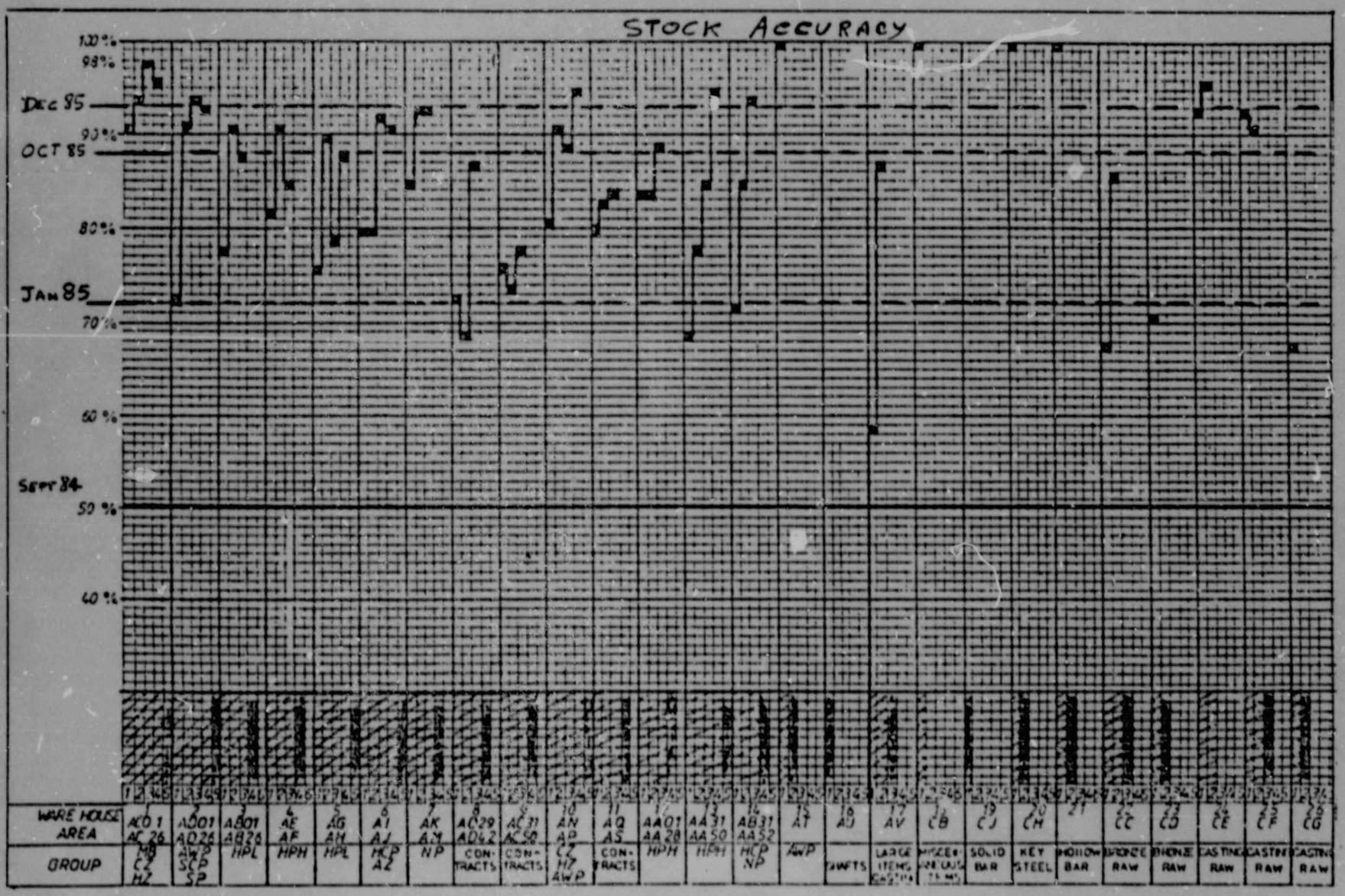
$$\text{cycle length} = \frac{1 - P}{P \bullet \text{Pr(variance)}}$$

15.4 APPENDIX D

1985 Cycle Count Accuracy Chart


STOCK ACCURACY
100%
98%
DEC 85
90%
OCT 85
80%
JAN 85
70%
60%
SEPT 84
50%
40%
WARE HOUSE AREA
GROUP
1 AC01 AC26 MB CZ HZ
2 AD01 AD26 AWP SCP S2
3 AB01 AB26 HPL
4 AE AF HPH
5 AG AH HPL
6 AI AJ HCP AZ
7 AK AM NP
8 AD29 AD42 CONTRACTS
9 AC31 AC50 CONTRACTS
10 AN AP CZ HZ AWP
11 AQ AS CONTRACTS
12 AA01 AA28 HPH
13 AA31 AA50 HPH
14 AB31 AA52 HCP NP
15 AT AWP
16 AU SWFTS
17 AV LARGE ITEMS CASTING
18 CB MIXED METALS
19 CJ SOLID BAR
20 CH KEY STEEL
21 HOLLOW BAR
22 CC BRONZE RAW
23 CD PHONIE RAW
24 CE CASTING RAW
25 CF CASTING RAW
26 CG CASTING RAW

STOCK ACCURACY



WARE HOUSE AREA	AC01 AC26	AD01 AD26	AB01 AB26	AE AF	AG AH	AI AJ	AK AM	AC29 AD42	AC31 AC50	AN AP	AQ AS	AA01 AA28	AA31 AA50	AB31 AA52	AT	AU	AV	CB	CJ	CH		CC	CD	CE	CF	CG
GROUP	MB CZ HZ	AWP SCP SP	HPL	HPH	HPL	HCP AZ	NP	CON-TRACTS	CON-TRACTS	CZ HZ AWP	CON-TRACTS	HPH	HPH	HCP NP	AWP	2WFTS	LARGE ITEMS CASTING	MISCELLANEOUS ITEMS	SOLID BAR	KEY STEEL	HOLLOW BAR	BRONZE RAW	BRONZE RAW	CASTING RAW	CASTING RAW	CASTING RAW