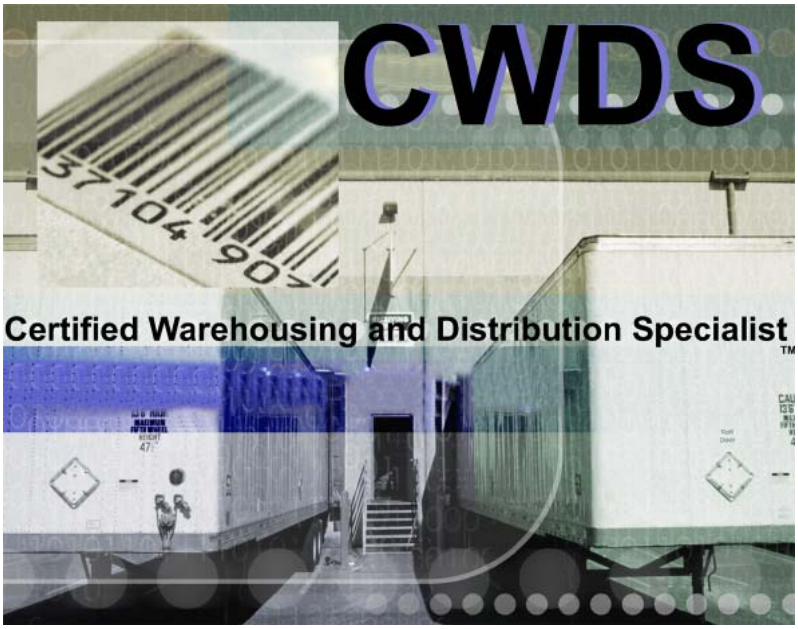

Warehousing Productivity Measures

QUICKSTART®
TECHNICAL COLLEGE SYSTEM OF GEORGIA

Published August 2002
(G081502)

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Introduction

Overview

All companies use measurements to monitor their business performance. By measuring their performance they are able to diagnose and correct problems. These measurements are called metrics. There are many different kinds of metrics that are used. Having a strong understanding of what each metric means is the key to improving warehouse operations. In this unit we will discuss the metrics commonly used by warehouses and distribution centers, what they measure, how to calculate them and the factors that can cause below-standard performance.

Objectives

The information, activities, and practice provided during this unit will enable the participants to:

1. List the four questions we must ask ourselves when establishing new metrics.
2. Define Benchmarking.
3. Determine the total number of orders, lines, or items picked over a given period.
4. Calculate the average orders, lines or items picked over a given period.
5. Define "man-hours."
6. Calculate the number of man-hours in a given period.
7. Define Order Completion Time.
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9. Explain Overages, Shortages and Damages.
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13. Calculate the Rate of Accuracy.
14. Explain the concept of Inventory Turns.
15. Calculate Inventory Turns.
16. Determine which warehouse has better Inventory Turns over another.

Metrics

Determining the metrics to use may seem like a difficult task but there are many measurements that are commonly used by the warehousing industry. Before deciding upon which metrics we want to use, we must ask ourselves four questions.

What are the Accomplishments of the Job?

Each job is different. Therefore we should carefully analyze each of the tasks associated with the job. An important part of this task analysis is to identify the inputs (e.g. number of trucks arriving, number of orders placed, number of pallets awaiting putaway). We should also take note of what is and what isn't under the control of the personnel completing the assignment.

What do we Want to Measure?

Once we understand the job accomplishments we must decide exactly what we want to measure. We should focus on the desired outputs (e.g. number of trucks unloaded, number of orders fulfilled, number of cases placed in locations). Focusing on what is important to our customers (both internal and external), we should pay special attention to areas where there are opportunities for errors and for improvement.

What is the Performance Scale?

After we determine what we are going to measure, we should determine the scale we will use. We might decide to use the raw numbers (e.g. the number of cases putaway) or a ratio (e.g. the number of cases putaway based on the number of cases delivered).

What is the Acceptable Range?

At first, establishing an acceptable range to grade the performance is difficult. Often we can only make a calculated guess. Although we may make the range too easy or too difficult to reach, it gives us a starting point. After time has passed we should adjust our range to a level that enables us to truly judge our performance.

Benchmarking

Benchmarking is the practice of measuring ourselves against other companies that perform similar functions as we do. Often these companies are considered to have excelled in the areas where we feel that we need to improve.

Benchmarking gives us the opportunity to witness how others have solved the problems that we face. It is especially helpful when a "breakthrough" approach is needed.

Progress Check #1

1. What are the four questions we should ask ourselves when establishing new metrics?

2. What is benchmarking?

3. Why is benchmarking beneficial?

Notes:

Warehousing Performance Metrics

As mentioned earlier there are many metrics commonly used by the warehousing industry. We will see how the metrics are calculated and discuss the probable causes for below standard performance.

Orders Picked

One measurement of a business's success is the number of orders it processes. More orders processed usually translates into more profits. Counting the number of orders picked is a gauge of how busy our warehouse is and the overall strength of our business.

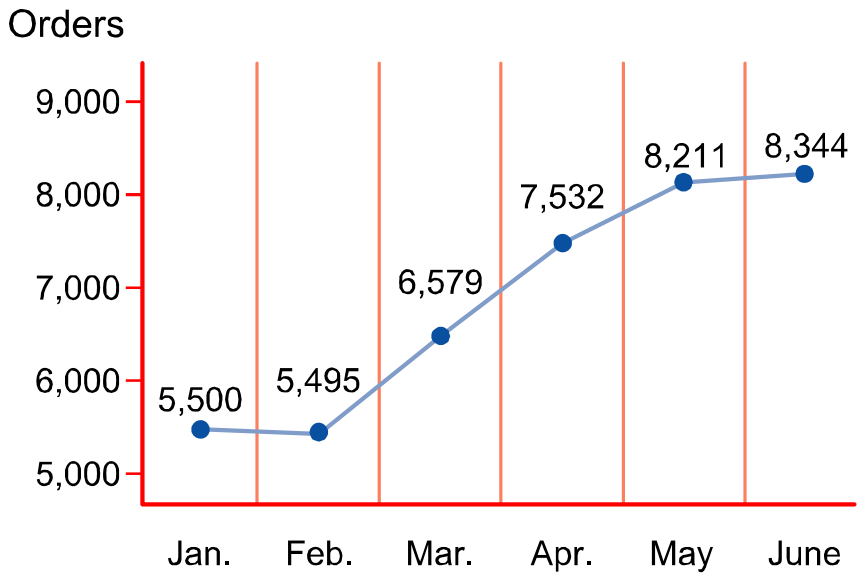
This metric can be calculated by adding the number of orders picked over a given period (hour, day, week, month, etc.). Depending upon the capabilities of the company, the data for this metric can be compiled from Daily Pick Lists or downloaded from the Warehouse Management System (WMS).

Sample Problem

Our company picked 5,500 orders in January, 5,495 in February, 6,579 in March, 7,532 in April, 8,211 in May and 8,344 in June. What was the total number of orders picked for the first six months of the year?

January	5,500
February	5,495
March	6,579
April	7,532
May	8,211
June	+ 8,344
Six-month Total	41,661

If we place the monthly data on a chart, we can see that orders have increased over the last six months.



Orders Picked

But the Orders Picked metric only tells us part of the information that we need to know. After all, each order probably has more than one item ordered. Usually a customer orders several items at once. If that is the case, our warehouse may be busier than we think.

Lines Picked

One of the most common metrics used by the warehousing industry is Lines Picked. This metric tells us how many line-items were removed from the warehouse to fill customer orders. It measures the amount of work performed by the order pickers. Obviously, if we have a lot of customer orders and those orders include multiple items our order pickers should be very busy.

This metric can be calculated by simply adding the number of lines picked over a given period. It can be done on an individual basis to compare the productivity of one order picker to another. Or, individual lines picked can be compiled to determine how productive our entire warehouse has been. It can be totaled daily, weekly, monthly, and yearly to show the trend of our orders.

As with orders picked, the data for this metric can be compiled from Daily Pick Lists or downloaded from the WMS.

Sample Problem

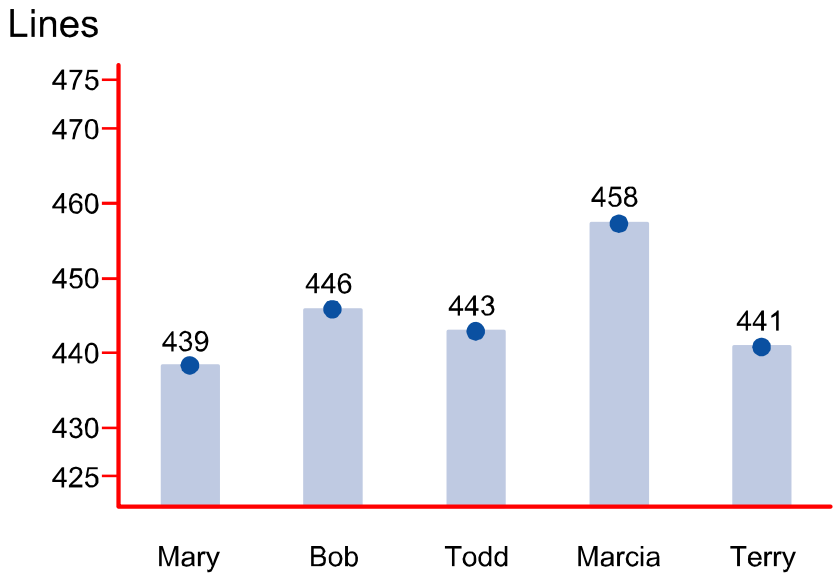
The supervisor must select the Order Picker of the Month. He has narrowed his selection down to five employees. These five have excellent attendance records and are all good workers. He decided to look at the number of lines picked for each of them.

Here is what he found:

	Lines Picked				
	Mary	Bob	Todd	Marcia	Terry
1st Week	121	113	112	118	110
2nd Week	104	100	102	108	112
3rd Week	115	124	132	129	121
4th Week	99	109	97	103	98
Monthly Total	439	446	443	458	441

Which person would you select as Order Picker of the Month?

Just as Orders Picked did not tell us everything we need to know about our picking, Lines Picked only provides us with partial information. Most orders not only have multiple line items but each line item may have different quantities.



Lines Picked

Items Picked

This metric takes into account the number of orders, the number of lines and the number of items picked. For some warehouses this may be a truer measurement of warehouse productivity.

Like Orders Picked and Lines Picked, Items Picked can be calculated by simply adding the number of items picked over a given period. It can be done on an individual basis to compare the productivity of one order picker to another. Or, Items Picked can be compiled to determine how productive our entire warehouse has been. It can be totaled daily, weekly, monthly, and yearly to show the trend of our orders.

As with the two earlier metrics, the data for this metric can be compiled from Daily Pick Lists or downloaded from the WMS.

Progress Check #2

1. The warehouse picked 1,145 orders during the first week of the month, 987 during the second week, 1,032 during the third week and 1,212 during the fourth week. How many orders were picked for the month?

2. The warehouse picked 28,756 items in January, 24,731 in February, and 26,777 in March. How many items were picked during the first three months of the year?

3. The new employee picked 53 lines on Monday, 43 on Tuesday, 67 on Wednesday, 75 on Thursday, and 71 on Friday. Most experienced order pickers at this warehouse pick 400 lines in a week. How many lines did the new employee pick?

Man-Hours

To further understand how metrics can be used, we must understand the concept of man-hours. One man-hour is the ideal amount of work accomplished in one hour. Ideally, if an employee is paid for eight hours each day, the company expects eight hours of work.

Unfortunately, many things can reduce a worker's productivity. Lack of orders, broken machinery, training new employees, vacation, etc. Because of these issues, managers must know how much work they are receiving from each employee. Once an average rate of work is determined managers can focus on eliminating the problems and increasing productivity.

Sample Problem

In a standard workweek, full-time employees work eight hours a day for five days. There are, therefore, 40 man-hours in a week for each employee.

Multiply number of man-hours in a day by the number of workdays in a week.

8 man-hours x 5 days = 40 man-hours per week

In a year a person works 2,080 hours.

Multiply the number of weeks in a year by the number of man-hours in a week.

52 weeks in a year x 40 man-hours in a week = 2,080 man-hours per year

Because of holidays, vacation, and sick-days, most companies round down that figure to 2000 man-hours per employee per year. We will use 2,000 man-hours as our standard.

Sample Problem

A warehouse employs 25 workers. How many man-hours should the warehouse personnel work in a five-day week?

Multiply 25 workers times 40 hours.

25 x 40 = 1,000 man-hours

How many man-hours should the 25 warehouse personnel work in a month if there are 22 working days?

Multiply 25 workers by 8 hours per day by 22 working days.

25 x 8 x 22 = 4,400 man-hours

Sample Problem

How many man-hours are there in a year for this warehouse?

Multiply 25 workers by 2,000 hours.

25 x 2,000 = 50,000 man-hours

Progress Check #3

1. A warehouse has 15 employees. How many man-hours should the warehouse personnel work during Thanksgiving Week? Note: The warehouse closes for Thursday and Friday for the holiday.

2. A warehouse has 20 employees. March has 20 workdays. How many man-hours should the warehouse personnel work for March?

3. A warehouse employs 74 people. How many total man-hours should the employees work during a year?

Notes:

Lines Picked per Hour

This metric calculates the average number of order lines picked per hour. This measures the productivity of the warehouse picking process. Once we know our productivity we can determine things like headcount requirements for any given period.

As with many metrics it can be done on an individual basis to compare the productivity of one order picker to another. Or, Lines Picked can be compiled to determine how productive our entire warehouse has been. It can be totaled daily, weekly, monthly, and yearly to show the trend of our orders.

Lines picked per hour is calculated used the following formula:

$$\text{Average Lines/Hour} = \frac{\text{Total Lines Picked}}{\text{Total Labor Hours}}$$

Sample Problem

Friday's night crew picked 756 lines during their eight-hour shift. What was their average lines picked per hour?

760/8 = 95 lines picked on average per hour

Sample Problem

The order picking team picked 28,896 lines during December. There were 21 working days in that month. The warehouse operates two eight-hour shifts. What was their average lines picked per hour?

We must first determine the number of labor hours available during December. This is done by multiplying the number of working days by the number of labor-hours in each day.

21 working days x 2 shifts x 8 hours per shift = 336 Total Labor Hours in December.

$$21 \times 2 \times 8 = 336$$

Then we complete the calculation using the formula:

$$\text{Average Lines/Hour} = \frac{\text{Total Lines Picked}}{\text{Total Labor Hours}}$$

$$\frac{28{,}896}{336} = 86 \text{ lines picked on average per hour in December}$$

The same process can be used to determine the Average Orders Picked per Hour (or day, or week, etc.) and the Average Items Picked per Hour (or day, or week, etc.)

Progress Check #4

1. The warehouse operates three 8-hour shifts. On Tuesday the first shift picked 563 lines, second shift picked 497 lines and third shift picked 356.

   a. What was the average number of lines picked per hour on second shift?

   b. What was the average number of lines picked per hour for all of Tuesday?

2. In 1999, the warehouse operated one 8-hour shift that picked 212,520 items. There were 253 workdays that year.

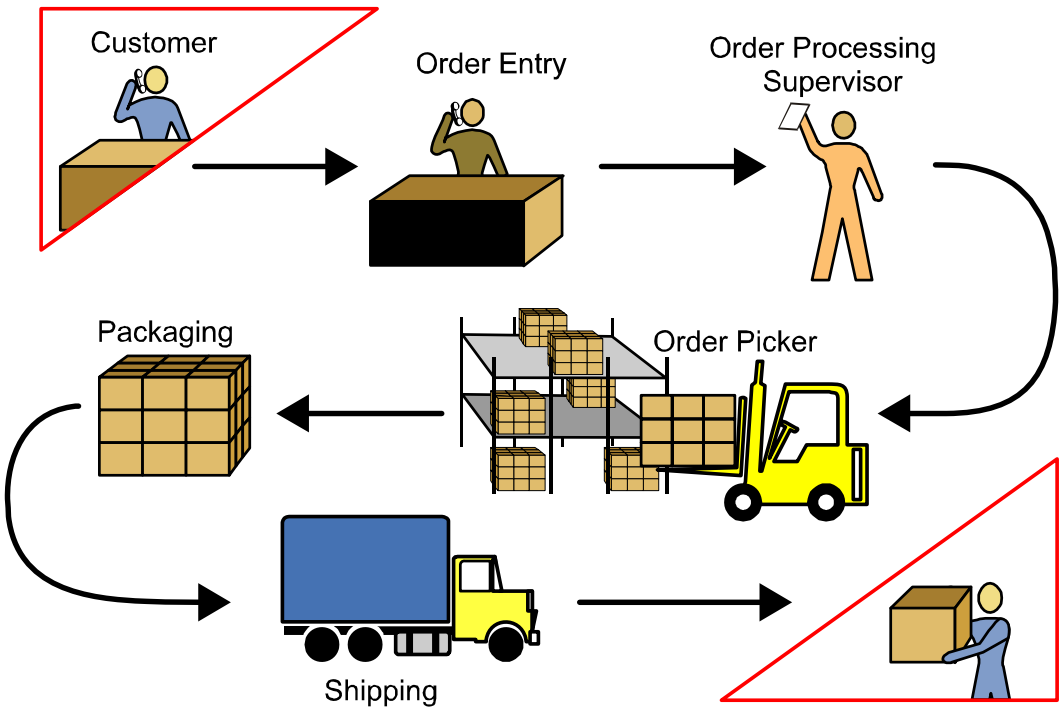
   What was the average number of items picked per hour in 1999?

Notes:

Order Completion Time

Order Completion Time (or Order Cycle Time) measures the time it takes an order to be processed. This may include the order-entry process, manufacturing or assembly of the items ordered, as well as, picking, packaging and shipping. In years past, Order Completion Time was measured in days or even weeks. In today's high-speed world of the Electronic Data Interchange (EDI) and the Internet, customers are requiring faster and faster deliveries. It is not uncommon for customers to demand 48-hour turnaround on an order.

Order Completion Time begins the moment a customer places an order. It ends when we ship the merchandise.



Order Completion Times

Sample Problem

A customer placed an order on Monday morning at 8:00 a.m. After verifying that the goods were in stock, the order-entry clerk passed the order to the warehouse at 9:15 a.m. The Order-Processing Supervisor batched the order with others and placed it in the picking queue. The order picker pulled the items at 2:30 p.m. The order arrived at the Packaging Area at 2:45 p.m. Since this warehouse only operates one shift, the order waited in the Packaging Area until 9:30 a.m. on Tuesday when it was prepared for shipment and staged at the shipping dock. As always, the delivery truck arrived at 2:00 p.m. and left at 2:30 p.m. What was the Order Completion Time?

Count the time from order-entry (8:00 a.m. Monday) until departure of the delivery truck (12:00 noon).

8:00 a.m. Monday until 8:00 a.m. Tuesday = 24 hours

8:00 a.m. Tuesday until 2:30 p.m. Tuesday = 6.5 hours

Total Order Completion Time =30.5 hours

While there are some aspects of the process that do not fall under warehousing's responsibility, we can do much to effect the measurement.

In the above example, what could the warehouse do to speed the order completion process?

Average Order Completion Time

While it is sometimes important to know the Order Completion Time of a particular order, it is more valuable to understand how long the order completion time is on the average. This is useful as a sales tool ("All orders received by 9:00 a.m. are shipped the same day!") and it is useful as a metric to help us improve.

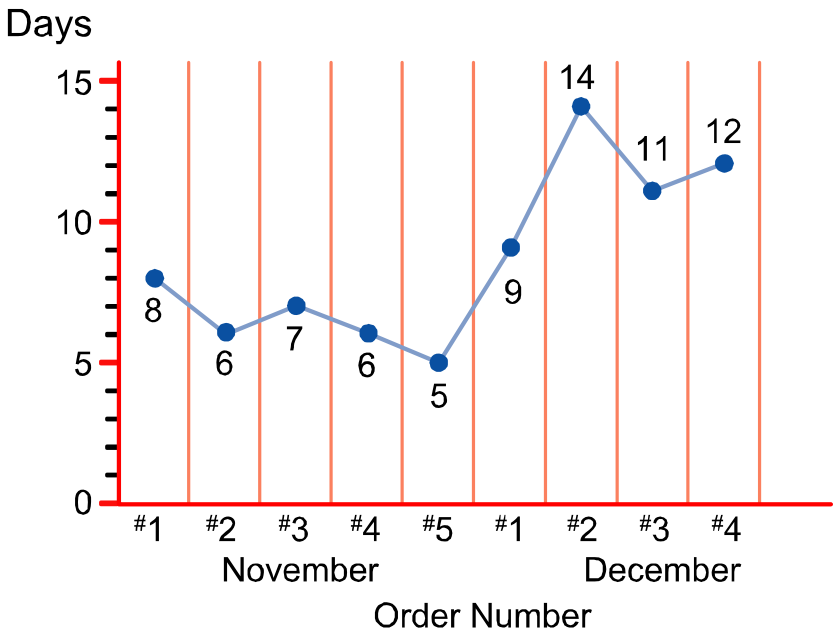
To determine the Average Order Completion Time we total all of the individual order completion times and divide by the number of orders.

Sample Problem

A good customer has complained that he always received our merchandise in less than a week and now it's taking almost two weeks. The Order Processing Supervisor looked at all the orders from this customer during the past two months and calculated the individual order completion times. Here is what she saw:

Order Completion Time

November	Order 1: 8 days	December	Order 1: 9 days
	Order 2: 6 days		Order 2: 14 days
	Order 3: 7 days		Order 3: 11 days
	Order 4: 6 days		Order 4: 12 days
	Order 5: 5 days		



Order Completion Time Graph

What was the Average Order Completion Time in November? In December?

Total the order completion times for each month then divide by the number of orders for that month.

8 + 6 + 7 + 6 + 5 = 32

32 / 5 = 6.4 days Average Order Completion Time in November

9 + 14 + 11 + 12 = 46

46 / 4 = 11.5 days Average Order Completion Time in December

Was the customer correct?

Obviously, calculating the Average Order Completion Time for a company that processes hundreds of orders each day is a monumental task. Luckily, most companies have computer systems that do the job for us.

By tracking the Average Order Completion Time on a daily, weekly or monthly basis we can judge whether or not we are improving.

Progress Check #5

1. An order was placed at 8:30 a.m. on Wednesday. It was shipped on the same day at 3:30 p.m. What was the Order Completion Time?

2. An order was placed at 11:00 a.m. on Tuesday. It was shipped on Friday at 3:30 p.m. What was the Order Completion Time?

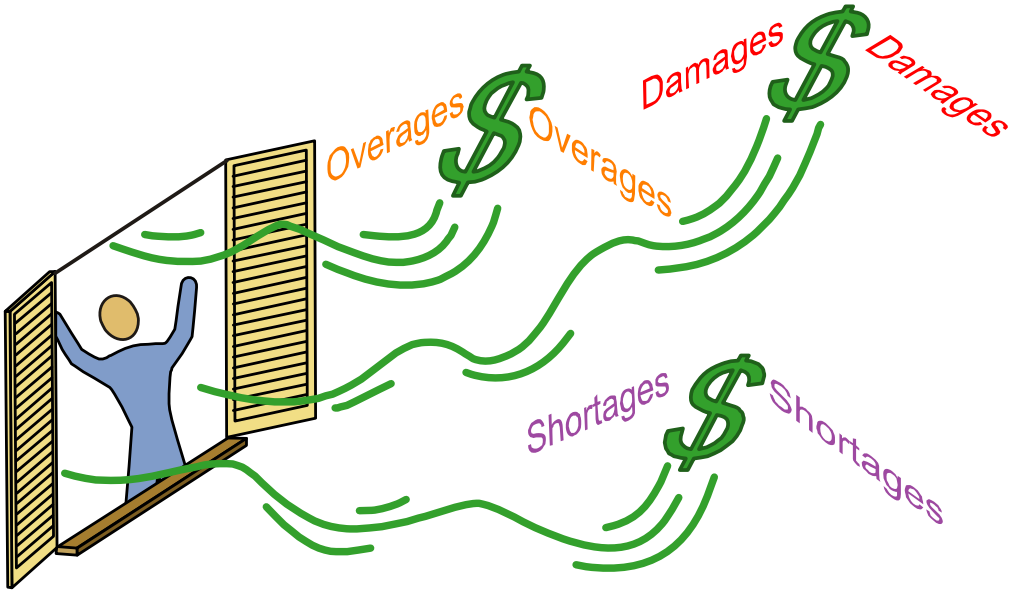
3. One company placed six different orders with our warehouse. The first was processed in 72 hours, the second in 36 hours, the third in 48 hours, the fourth in 48 hours, the fifth in 64 hours and the sixth in 24 hours. What was the Average Order Completion Time for this customer's orders?

4. Third Shift processed 40 complete orders in 8 hours. What was their Average Order Completion Time?

Overages, Shortages and Damages

Overages (too much merchandise), shortages (too little merchandise) and damages (broken merchandise) are going to occur in every warehouse. Items that fall into this category are called "unsaleables." Preventing these losses is a major concern of every warehouse. We can get ahead in the game by taking careful measurements of our OS&D rates and then working to reduce them.

Overages and shortages are often caused when buyers overestimate or underestimate the sales potential of some items. They may order too much or not enough. Suppliers may inadvertently ship excess quantities or fail to ship others. Working closely with customers and suppliers will improve forecasts.



Lost Profits Due to OS&D's

Overages (or overstocks) waste money that could have been spent elsewhere. If we have too much in stock, it takes up valuable warehouse space. If we inadvertently ship extra merchandise, it results in loss of profit.

Shortages upset customers and can result in lost orders.

The rate of Overages and Shortages can be calculated by dividing the number of orders over/short by the total number of orders. Multiply by 100 to obtain the percentage.

Sample Problem

Last month a warehouse experienced 416 shortages. It processed 13,866 orders. What was its Shortage Rate?

Divide the number of orders that were short by the total number of orders.

(416 / 13866) x 100 = (.03) x 100 = 3 %

Damages

The greatest contributor to damages is in handling. Many handling issues need to be addressed to keep damages to a minimum.

Often items arrive at the warehouse already damaged but we are unaware of it. New lightweight containers may contribute to the problem. Careless handling in the warehouse cause additional damage.

Monitoring the amount of product damaged enables us to focus on the problem and tells us if we are improving or not.

Damage is usually calculated in dollars. The Rate of Damage is calculated by dividing the total cost of the damaged goods by the total cost of the items received or shipped.

Sample Problem

We have been receiving a large amount of damaged goods from one of our suppliers. They have shipped us $75,689 worth of goods. We determined that the damaged merchandise cost us $7,600. What was the Rate of Damage?

Divide the total cost of the damaged goods by the total cost of the items received.

$7,600 / $75,689 = 10% (approximately)

Sample Problem

We have received $33,289 in returns from our customers this past month. They complain that the items were damaged when they received them. We shipped $416,000 worth of goods during that period. Our normal Rate of Damage is less than 1%. What the Rate of Damage for last month?

Divide the total cost of the damaged goods by the total cost of the items shipped.

$33,280 / $416,000 = 8%

Progress Check #6

1. We processed 1,578 orders in October. We shipped 301 orders with shortages. What was our Rate of Shortages?

2. We received $50,000 worth of merchandise in July. Our warehouse staff was responsible for damaging $1,500 worth of merchandise. What was our Rate of Damage?

3. One of our suppliers has shipped us 30 orders this month. Three of the orders had overages. Six others had shortages. Another was crushed. What was their Rate of Overages?

4. What was our supplier's Rate of Shortages?

5. What was our supplier's Rate of Damage?

Errors/Mispicks

Another common problem in every warehouse is errors in picking or mispicks. Although human error makes up the vast majority of mispicks, even fully automated systems can make errors.

To prevent mispicks from making it to the customers, many warehouses have put inspection processes in place. These inspectors may work for a quality control or inventory control department or they may work directly for the Order Picking Supervisor.

Some companies inspect 100% of their outgoing orders to prevent shipping incorrect items. This can be very labor intensive and cost a lot of money. Others use a "sample check" where they check only a percent of the orders for correctness. This reduces the cost and, if done correctly, gives us an accurate picture of our pick accuracy.

Once we understand our accuracy rate we can work on improving it.

The Rate of Errors/Mispicks is calculated by totaling all our errors/mispicks and dividing them by the total number of orders picked.

Pick Accuracy is calculated by subtracting the Rate of Errors/Mispicks from 100%.

Sample Problem

On Thursday, we picked 450 orders. All were inspected. The inspectors found 17 orders were short items, 28 had overages and 44 had wrong items. What was our Rate of Mispicks?

Add the total number of errors/mispicks and divide them by the total number of orders picked.

17 Shortages + 28 Overages + 44 Wrong Items = 89 Errors/Mispicks

89/450 = 19.8% Error/Mispick Rate

What was our Pick Accuracy Rate?

Subtract the Rate of Errors/Mispicks from 100%.

100% - 19.8% = 80.2% Pick Accuracy Rate

The Rate of Pick Accuracy is sometimes referred to as the Rate of Reliability.

Progress Check #7

1. We picked 567 orders this week and our inspectors discovered 3 shortages and 2 overages and 12 wrong items. Our Rate of Error/ Mispicks has always been below one percent. What was our Rate of Error/Mispicks this week?

2. Last month we picked 2,467 orders. Here is what the inspectors found:

	Overages	Shortages	Wrong Items
Week 1	13	25	11
Week 2	0	17	28
Week 3	23	2	17
Week 4	14	20	15

   What was our Rate of Pick Accuracy for last month?

3. The new employee picked 81 orders on his first day. Everyone was quite pleased until they realized that he had 45 mispicks. What was the new employee's Rate of Errors/Mispicks?

4. While on a benchmarking trip we visited another company whose reputation was very good in the industry. They explained to us that they picked 1,250,000 orders last year with only 2500 mispicks. What was their Rate of Pick Accuracy?

Notes:

Inventory Turns

Remember that inventory is managed by moving it quickly through the warehouse.

Inventory Turns is a concept of how fast the inventory "turns over" completely, on average for a given period (normally a year). It is an excellent tool that gives managers visibility to the levels of inventory and how fast it is moving.

If we manage our warehouse properly, we will only stock what we need; no more, no less. We will have it delivered just before it is required (Just-in-Time). We will not have overages or shortages. This will dramatically reduce inventory costs.

The faster we turnover our inventory, the faster we are fulfilling orders.

If we have obsolete or excess material, we have wasted our money.

Inventory Turns are calculated by adding the dollar-value of all of the material needed for our orders for the year (Gross Requirements) and dividing it by dollar-value of the total inventory on hand (Gross Inventory).

Sample Problem

A manufacturing firm used $1.3M in material for its yearly orders. It maintained $650,000 of materials in the warehouse. What were its Inventory Turns?

Add the dollar-value of all of the material needed for the orders for the year and divide it by dollar-value of the total inventory on hand.

$1,300,000 / $650,000 = 2 Inventory Turns

Sample Problem

A competitor of the previous manufacturer has about the same amount of order requirements for a year ($1.3M), but is able to meet those requirements while maintaining $325,000 worth of inventory. What were its Inventory Turns?

Add the dollar-value of all of the material needed for the orders for the year and divide it by dollar-value of the total inventory on hand.

$1,300,000 / $325,000 = 4 Inventory Turns

Which manufacturer is more profitable?

How do you think the second manufacturer is able to accomplish this?

Progress Check #8

1. A warehouse has $7.5M in Gross Requirements. It maintained $1.5M in inventory. What were its Inventory Turns?

2. A warehouse had $1B in Gross Requirements and had just over $10M in inventory. What were its Inventory Turns?

3. One Company has Gross Requirements of $3.3M while maintaining $550,000 in inventory. Another had Gross Requirements of $3.6M while maintaining $1.2M in inventory. Which had better Inventory Turns?

Notes:

Summary

As you can see, there are many different kinds of metrics that are used. By measuring the warehouse's performance we are able to diagnose and correct problems. Having a strong understanding of each metric is a key to improving warehouse operations.

Notes:

Glossary

Benchmarking	The practice of measuring our company against other companies that perform similar functions as we do.
EDI	Electronic Data Interchange.
Electronic Data Interchange	The computer to computer transmission of business information using a public standard format.
Gross Inventory	The total of all inventory on hand.
Gross Requirements	All the material needed for orders for the year.
Inventory Turns	A concept of how fast the inventory "turns over" completely, on average, for a given period (normally a year).
Man-hours	The ideal amount of work accomplished in one hour.
Metrics	Measurements used to monitor a business' performance.
Mispicks	Errors made during the order picking process.
OS&D	Overages, Shortages and Damages.
Pick Accuracy	A measurement of correct picks made during the order picking process.
Productivity	A measurement of the amount of work accomplished in a given period.

Turns	See Inventory Turns.
Warehouse Management System	A manual or computerized system that enables a warehouse to track all items in the facility.
WMS	Warehouse Management System.