

# The Financial-Supply Chain Management CONNECTION

This is the second in a series of three articles by Dr. Stephen G. Timme, President of FinListics® Solutions and Adjunct Professor at the Georgia Institute of Technology in Atlanta, Georgia.



## Total Cost of Holding Inventory

### Introduction

Management of inventory is a key driver of financial performance. Many companies today are exploring new ways to better manage inventory in response to slowing growth and pressures on profitability. Despite the importance of inventory management, there appears to be little consensus on a framework for estimating the total cost of holding inventory which is a critical component in analyzing the benefits and costs associated with changes in inventory.

This article explores the key factors comprising the total cost of holding inventory—non-capital carrying costs and capital carrying charges. It shows that many companies currently use a total cost of holding inventory that is significantly less than the one that should be utilized. Use of an understated total cost of holding inventory can lead to non-optimal inventory-related decisions involving transportation, procurement, network optimization, warehouse automation, and others.

### Total Cost of Holding Inventory

The elements that make up the total cost of inventory are shown in Exhibit 1. The total cost of holding inventory is often expressed as a percentage of inventory to facilitate comparison over time and across companies.

### Inventory Non-Capital Carrying Costs

Our experience is that for decision-making purposes, a percentage in the range of 10% is often applied. This percentage tends to vary by industry with a key driver being the risk of obsolescence.

Lack of credible estimates result in inventory non-capital carrying costs benefits being discounted, or even omitted, from many SCM initiatives which understates the real value of these initiatives.

Let's say an initiative is expected to permanently reduce inventory by \$10 million. The variable non-capital carrying costs as a percentage of inventory is 10%. The marginal tax rate is 40% and the after-tax cost of capital is 9%. Exhibit 2 shows that the value of this initiative is the change in the value of inventory of \$10 million if non-capital carrying costs are excluded. However, the value is substantially higher—almost \$17 million—when the impact on non-capital carrying costs is included.

EXHIBIT 1

Total Cost of Holding Inventory	
Warehousing	
+ Obsolescence	
+ Pilferage	
+ Damage	
+ Insurance	
+ Taxes	
+ Administration and other	
<b>= Total Inventory Non-Capital Carrying Costs</b>	
Plus	
Inventory	
x Cost of capital	
<b>= Inventory Capital Charge</b>	

The application of the wrong cost of capital is often related to:

- mismatch between the risk of inventory and the cost of capital
- mixing after-tax capital charges with before-tax non-capital carrying charges

The cost of capital is the opportunity cost of investing in an asset relative to the expected return on assets of similar risk. Ascertaining the risk of inventory is the most critical element in deciding what cost of capital should be used to calculate the inventory capital charge. The major risk of holding inventory is that its value becomes impaired.

### Use Weighted Average Cost of Capital for Inventory

Given the inherent risk of inventory, it's recommended that a company's Weighted Average Cost of Capital—also referred to as WACC—can be used in calculating the inventory capital charge.

WACC is comprised of the cost of equity and the after-tax cost of debt. The cost of equity is the cost of providing shareholders competitive returns on their invested dollars. The cost of debt is simply the overall interest rate on debt taken on to finance projects, reduced by the tax benefit of interest expense. Expressed as a percentage, cost of capital is the average of the required return on equity and the interest rate on debt, weighted by the proportion of equity and debt, respectively, to total capitalization.

For the average company in the United States, a representative estimate of WACC is approximately 9%. The average WACC for a sample of high-tech companies is approximately 13.0%, whereas for a group of grocery stores, it's approximately 7.0%. It's important to note that the WACC is an after-tax rate.

EXHIBIT 2

Illustrative Valuation of Change in Inventory*		
Inventory Change	Non-Capital Carrying Costs	
	Included	Excluded
	\$10.0m	\$10m
% Non-capital carrying	10.0%	N/A
Change in non-capital carrying costs	\$1.0m	N/A
Tax rate	40.0%	N/A
Taxes	\$0.4m	N/A
Change in annual after-tax profits	\$0.60	N/A
<b>Present value of after-tax profits @ 9.0% cost of capital</b> (\$0.6m / 9%)	<b>\$6.7m</b>	<b>N/A</b>
<b>Total value (Inventory change + PV of after-tax profits)</b>	<b>\$16.7m</b>	<b>\$10.0m</b>

\*excludes cost of initiative

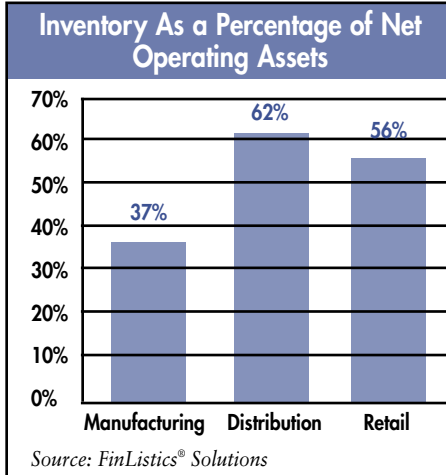
### What Cost of Capital?

When calculated correctly, the inventory capital charge often exceeds the non-capital carrying costs. Unfortunately, the capital charge is often underestimated because the wrong cost of capital is applied.

## Why Use WACC for Inventory Capital Charge?

For many industries, inventory is a significant portion of its net operating assets and, in turn, a key source of risk. Exhibit 3 shows inventory as a percentage of net operating assets for a sample of companies from manufacturing, distribution, and retail.

EXHIBIT 3



Despite the inventory's significant contribution to risk, many companies apply a cost of capital that is substantially lower than the WACC, such as a short-term borrowing or investment rate that is appreciably lower than the WACC. Both of these rates understate the capital charge that is commensurate with the underlying risk of inventory. This can lead to non-optimal decisions for activities that balance inventory investment against operating expenses, like mode of transportation, network design, and sourcing.

## Before-Tax Total Inventory Carrying Costs

Now let's combine the inventory non-capital carrying charge with the capital carrying charge to estimate the total cost of holding inventory. In our example, the non-capital carrying cost is 10% of the inventory balance and the after-tax cost of capital is 9.0%.

Even when WACC is used to calculate the inventory capital carrying charge, a common flaw in estimating the total cost of holding inventory is that the **before-tax percentage inventory non-capital carrying costs** (like 10.0%) is added to the **after-tax cost of capital** (like 9.0%) for a total carrying cost of 19.0%. These before- and after-tax costs should not be combined. Doing so understates the total cost of holding inventory.

To combine these two costs, they must be stated on the same basis. There are two options:

- **Option 1:** Adjust the before-tax percentage inventory non-capital carrying costs

to an after-tax figure, and add this to the after-tax cost of capital.

- **Option 2:** Convert the after-tax cost of capital to a before-tax number and add it to the before-tax percentage non-capital carrying cost.

Total inventory carrying costs are often used for periodic internal reports and decisions that are evaluated at the operating level on a before-tax basis. Therefore, it's recommended that, for these purposes, Option 2 be used to estimate the total cost of holding inventory. For traditional financial analysis involving the discounting of after-tax cash flow, Option 1 should be utilized.

Exhibit 4 shows the derivation of the before-tax cost of capital and total inventory carrying costs.

EXHIBIT 4

Percentage non-capital carrying cost		<b>10.0%</b>
After-tax weighted average cost of capital	9.0%	
Marginal tax rate	40%	
Before-tax cost of capital (9% / (100% - 40%))		<b>15.0%</b>
Total inventory carrying costs as percentage of inventory		<b>25.0%</b>

The 9.0% after-tax weighted average cost of capital restated on a before-tax basis is 15.0%, which is the 9.0% grossed-up for taxes. The rationale is that if a company earns 15% before taxes, and pays 40% of the 15.0% in taxes (6.0% = 15.0% x 40%), it earns 9.0% after tax (15.0% - 6.0%).

## Application

The following shows an application using the total cost of holding inventory. It also compares the use of the 25% total cost of holding inventory shown in Exhibit 5 to a commonly used total cost of 15.0%. This 15.0% figure is the sum of a 10.0% non-capital carrying cost with a short-term rate of 5.0% for the capital carrying cost. The 5.0% is a before-tax figure, and doesn't need to be adjusted for taxes.

The example is based on a company with a \$100 million in inventory. Sales and operating income margin are based on a sample of distribution companies.

EXHIBIT 5

Inventory	\$100m	\$100m
Percentage total cost of holding inventory	25.0%	15.0%
<b>Total cost of holding inventory</b>	<b>\$25.0m</b>	<b>\$15.0m</b>
Sales	\$750m	\$750m
Operating income margin*	4.0%	4.0%
<b>Operating income*</b>	<b>\$30m</b>	<b>\$30m</b>
<b>Operating income absorbed by total cost of holding inventory</b>	<b>83%</b>	<b>50%</b>

\*excludes non-capital inventory carrying cost of \$10 million (\$100m inventory x 10% non-capital carrying costs)

The use of the more accurate percentage of 25% reveals that the total dollar cost of holding inventory is **\$10 million higher** than when applying the lower 15.0% (**\$25 million vs. \$15 million**). To put the \$10 million difference into practical perspective, the \$25 million represents over 80% of operating income being absorbed by total inventory carrying costs, whereas the estimated percentage is 50% when the lower 15% is applied.

Communicating an accurate estimate of the percentage of operating income absorbed by total inventory carrying costs is an effective means of:

- developing a better understanding of the relative cost of holding inventory
- motivating an enterprise-wide view of inventory management
- stimulating initiatives to improve inventory management

**Conduct an analysis like the one shown in Exhibit 4 for your company by using the template *Total\_Cost\_of\_Holding\_Inventory.xls* located on the *Finlistics Analysis Template* link under *RESOURCES/Members Only/Logistics Comment Newsletter* under the *March/April* link at [www.clm1.org](http://www.clm1.org).**

## Summary

SCM professionals should develop better estimates of non-capital carrying costs. Also, many companies use a cost of capital that significantly understates the inventory capital carrying charge. This can lead to non-optimal transportation, sourcing, network design, and other decisions. It's recommended that the weighted average cost of capital be used to calculate the capital carrying charge since it's commensurate with the risk of inventory and incorporates a company's targeted capital structure. ■