

**Demand-Driven**  
**Inventory**  
**Optimization** **and**  
**Replenishment**

**Creating a More Efficient Supply Chain**

**Robert A. Davis**

**WILEY**



From *Demand-Driven Inventory Optimization and Replenishment*. Full book available for purchase [here](#).

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# Contents

**Foreword** xiii

**Preface** xvii

**Acknowledgments** xix

**Chapter 1 Creating Demand-Driven Supply** 1

- The Path to Demand-Driven Supply 3
- Shifting from Supply-Driven to Demand-Driven Methodologies 4
- Moving to a Demand-Driven Supply 9
- Creating My Island of Efficiency 11
- What Is an Island of Efficiency? 13
- Notes 16

**Chapter 2 Achieving Timely and Accurate Responses to Customer Demand** 17

- Push and Pull Supply Chains 18
- Enter Toyota and the Kanban System 20
- From Kanban to Just-in-Time Production 22
- What Is Needed for a JIT System to Work Efficiently? 23
- A Broader View of JIT/Kanban in Action 25
- The Known Demand Becomes the Predictable Demand 26
- The JIT Production Supply Chain Weaknesses Become Amplified in the Distribution Chain 29
- Some Distribution Issues 29
- The Customer Pushes Back 30
- The Squeeze Is On 31
- Creating an Efficient Supply Chain Using JIT Functionality 32

Push-Pull Tipping Points 34  
In Search of True Demand 35  
Notes 38

**Chapter 3 Just-in-Time and Enterprise Resource Planning  
Rise Together 39**

Denormalized Tables 40  
Sequential Optimization 43  
Upstream Service Levels 44  
Accumulated Demand Variance 46  
Multiple Hierarchies of Service Level Requirements 47  
The Effects of ERP Shortcomings 48  
Shifting Costs on a Balance Sheet 49  
Moving the Focus Away from Inventory to Replenishment 50  
The Long Tail 53  
Making Mistakes Faster 57  
Working with One Hand Tied behind Your Back 58  
So, Here We Are 60  
Notes 61

**Chapter 4 How Does Days of Supply Wreak Havoc on the  
Supply Chain? 63**

Rule-of-Thumb Days/Weeks of Supply Exposed 64  
Inefficiencies of Rule-of-Thumb Days of Supply 68  
Turning Days of Supply on Its Head 74  
Creating the Efficiency Envelope 77  
The Journey, So Far 80  
Notes 82

**Chapter 5 What Will You Accomplish with Inventory  
Optimization? 83**

How Does Inventory Optimization Improve  
the ERP Systems? 84  
Development of the Inventory Policies and Replenishment  
Plans 85

The Network Structure	85
The Service Level	86
The Lead Time and Lead-Time Variance	87
Ordering Rules	88
Demand	89
Developing Policy Outputs	90

## **Chapter 6 Fitting Unlimited Optimization into a Constraining World 105**

The Present State of Affairs in Replenishment Planning	106
How Alerts Take on More Significance When Customer Service Is Paramount	107
Time	108
Space	109
The Comingling of Demand	110
The Short Supply or Allocated Product	112
Where Does “Optimized” Replenishment Need to Go in Order to Encompass the Entire Distribution Chain?	114
The Upstream Reaction	115
Moving Upstream Reactions into Real Replenishment	119
Replenishment as a Means to Inventory Optimization Harmony	123

## **Chapter 7 Reviewing the Three Proof of Value Engagements 125**

Proving That Inventory Optimization Is a Good Business Rationale	126
The Good: When Proof of Value Engagements Work	127
The Bad: When Proof of Value Engagements Don’t Work	133
The Best: A Complete Proof of Value Engagement	139
Looking Back	155

## **Chapter 8 Inventory Optimization in the Real World: Matas A/S 157**

Matas A/S: Automated Forecasting and Replenishment	159
What Were the Problems at Matas?	160

DC Replenishment	161
Store Replenishment	162
A Project in Inventory Optimization	163
A Pilot Program versus a Proof of Value Process	167
Rolling the Project Out to the Enterprise	169
The Matas Network	171
A Closer Look at the Optimization Process	172
The Ultimate Matas Goal	177
The Matas Results	178
Reflections on the Project	180

## **Chapter 9 A Consultant's View of Inventory Optimization 181**

Who Is Anders Richter?	182
In Closing	199
Note	200

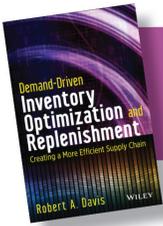
## **Chapter 10 Pulling It All Together 201**

Aligning the Inventory Optimization Goals to Correct Deep-Seated Business Actions in a Company	204
Inventory Optimization Can't Do What Was Done Before	204
How to Change the Playing Field	205
Overarching Business Issues Impede Positive Inventory Control	206
Supply Chain Inventory Strategies Benchmark Report Recommendations	210
In Closing	213
Notes	214

## **Epilogue 215**

## **About the Author 219**

## **Index 221**



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## CHAPTER 1

# Creating Demand-Driven Supply

*Anyone who isn't confused really doesn't understand the situation.*

—Edward R. Murrow

When people talk about inventory optimization I am always surprised at the number of definitions that are rolling around out there. Most C-level executives know it has something to do with reducing or right sizing inventories and that it really helps control supply chain costs. The career path of that C-level executive can morph her viewpoint about where that optimization resides. Indeed, the closer you get to the customer, the more optimization means replenishment. This means a retail executive has a far different view of optimization compared to that of a manufacturing executive.

Oftentimes, the focal point of so-called supply chain efficiency projects is to uncover and exploit cost discrepancies positioned by supply chain partners in the name of “optimization.” For instance, in the article “Optimizing Replenishment Policies Using Genetic Algorithms for Single Warehouse/Multi-retailer System,” W. Yang, T. Felix, S. Chan, and V. Kumar cite how huge savings can be achieved by adhering to a methodology of quantity discounts in transportation cost models.<sup>1</sup> This technique of uncovering supply chain inefficiencies to fill the void with cost savings that might shift costs onto another portion in the

supply chain is rampant in the industry. Obviously, the whole point of optimization is to take advantage of every opportunity of cost savings, not just taking advantage of trading partner inefficiencies. At risk are the constant problems of simply shifting the costs from one location to another and the actual elimination of the costs and the savings enjoyed by either the network as a whole or the end customer satisfaction.

This is why we oftentimes find supply chain executives perplexed about where to start in developing a fact-based pathway to better supply chain dynamics. There seem to be a million different definitions of what inventory optimization is, depending on what flavor of optimization is in vogue. At one time the flavor might be *network design* to drive best positioning at the moment of a warehouse. Another time it might be a *theory of constraints* project to uncover bottlenecks in the company supply chain that can be smoothed out. Conversely, it might even be a project about *SKU (stock keeping unit) rationalization* for overall portfolio profitability. I have heard them all batched under the banner of inventory optimization. However, nothing has created more confusion than a definition driven out of the just-in-time wave of supply chain efficiencies—the idea that a company that practices *pull supply chain* methodologies will suddenly enjoy massive inventory savings and replenishment nirvana. Nothing could be further from the truth.

There is nothing wrong with the assumption that replenishment is what drives supply. In fact, given my background I would almost wholeheartedly agree. Over the past 30 years supply chains have been shifting from being supply-driven (push) to being demand-driven (pull). While the theory is easy to imagine, the devil is in the details. There are decades of supply-side or push-style supply chain practices in place throughout organizations. You can't simply flip a switch and make your supply chain work in a new way.

Originally, the thought of most companies was to make a complete shift from push to pull as a way to have a nimble and/or agile supply chain. In an article written back in 2003,<sup>2</sup> Erik Kruse talks about some of the disastrous results companies incurred when they took perfectly good operating systems that insured efficiencies when producing large quantities of standardized products and attempted to make smaller batches of products to quickly “react” to customer demand. He points out an AMR Research study that supports his claim of inefficiencies.

In that study, it was shown that companies tend to reconfigure their physical networks without introducing new processes that would help in the transition. Kruse points out that if customers don't buy what the efficient operations are producing, then the efficiency metric isn't really measuring true efficiency.

This brings up an interesting paradox. If you only use supply-side/push methodology, your operations can be extremely efficient. Large amounts of standardized product can be positioned, but if the customer is not buying the product at the same rate, the real efficiency is lost. In turn, if you shift to a demand-side/pull methodology, you reduce the production cycle and produce just enough to satisfy customer demand. When this occurs, you lose your manufacturing efficiencies, and you run the risk of not fulfilling *unexpected* customer demand.

Various large-scale supply chain movements like just-in-time, efficient consumer response, and collaborative planning, forecasting, and replenishment have all been rolled out in the name of creating a more responsive organization. The introduction of enterprise resource planning (ERP) and supply chain management (SCM) solutions in the late 1990s helped these movements gain traction, as technology interacted with methodology. Oddly, as technology and methodology interconnected, it seemed as though the supply chain industry was simply creating a bigger, better, and faster replenishment engine as a way of having an optimized supply chain. What is becoming more and more apparent, though, is that replenishment can only do so much in an effort to become demand driven. In the end, replenishment can only attempt to compensate for out-of-balance inventories.

## THE PATH TO DEMAND-DRIVEN SUPPLY

This book is designed to take business practitioners through the fundamentals of inventory optimization so that they can attain a demand-driven supply. If you are looking for a book that will spell out stochastic algorithms, you're in the wrong place. Virtually every book written on the subject of "inventory optimization" seems to be done by academics with complete focus on proving that the stochastic algorithms they used during their studies are sound and repeatable. The business world has heard about the subject, but has trouble linking

the solution to the many supply chain problems they might have in their organization. My goal is to provide a business perspective on why present inventory systems suboptimize the supply chain and why faulty replenishment processes lead to wasted time and effort. In the end I hope the reader would come away with a good understanding of why *optimized inventory* and *replenishment* help overcome in-system weaknesses and deliver results. We've come a long, long way, and it seems as though we only have a few more hurdles to go before we become part of the end game known as demand-driven supply.

When I am in front of executives who think replenishment cures their supply chain, I often ask the question: "If replenishment takes care of inventory ills, what caused the inventory to be sick in the first place?"

While it is not the only place of supply inefficiency, let's take a look at the grocery supply chain in the United States. Because of the normal interactions people have with their grocery stores, they can recognize some of these push-style methods companies used to entice you to buy products you wouldn't otherwise have purchased in the name of pushing products through the supply chain.

## **SHIFTING FROM SUPPLY-DRIVEN TO DEMAND-DRIVEN METHODOLOGIES**

Thirty-five years ago, just before the demise of the so-called push supply chain in grocery products, I made a personal transition from being a supply-driven buyer to being demand-driven buyer. First of all, at the time I didn't know what any of this supply-demand mumbo jumbo meant, and, second of all, I never set out to be a buyer in the first place.

### **So You Think You Can Do Better?**

I was working as a key account manager in Portland, Oregon. My job was to manage grocery headquarter accounts for best results in sales. It was getting close to the end of the fiscal year, and we were slightly below the numbers I needed to bring in. One of my accounts was a co-op wholesaler who supplied almost all of the large, independent grocery stores in the northwest region. My buyer, Joanne McBride, did not have any direct responsibility for the advertising, but purchased

for both turn and promotional merchandise. I was good friends with her. I was also really needling her to order a little more so I could make my year-end numbers. What she did next changed my life forever.

She looked at me and said in a very tired and very sarcastic voice, “Bob, you think you’re so hot stuff. Why don’t you do it?”

I was stunned. Now what am I going to do? However, never being the one to back down, I said, “Okay,” and picked up the two orders so that I could get the heck out of there. I went downstairs to the lunchroom with a calculator and a very sharp pencil. The only instructions I got from her that day were the following:

- There are four numbers that show the running “as is demand” by week with the most recent on the left.
- If there are any ads planned for the product, they will show up above the order line with the price and the placement—feature or subfeature.
- The order suggestions are forecasted only for turn volume. You must figure out what needs to be ordered for the advertising.
- Once you have the total amount, make sure the goods can fit in a truck ranging from 38,000 to 44,000 pounds.

For the next two-and-a-half hours, I was sweating bullets. After using up the calculator batteries, most of the pencil, and the entire eraser I was able to put together two trucks for the Portland warehouse and one truck for the Medford warehouse. I took the orders up to Joanne and handed them over for the judgment. She looked at them and said, “Not bad, but anybody can buy just once. Let’s see what you can do over the long haul.”

Yep, you guessed it—I was suddenly doing vendor-managed inventory (VMI) 20 years before it was cool.

Let’s not get ahead of ourselves here. I wasn’t shifting the product ownership points or taking on an official role of a VMI person. I was just a key account manager who got handed the keys to a treasure chest. My job at that point was to go into the wholesaler, pick up the computer-generated ordering output for the two wholesaler warehouses in Oregon, and develop orders to cover general turn volume and major advertising.

At the time—remember this was the mid-1980s—there were two completely different inventory management philosophies between a grocery vendor and a grocery wholesaler. Grocery vendors were graded on sheer volume flowing out to the end customer. On the flip side, the grocery wholesaler focus was on efficient inventory turns.

In the middle of this conflict was an old adage uttered by just about every grocer vendor in the business: “A happy buyer is a loaded buyer.” The crux of this statement was that in order for the grocery wholesaler to be efficient you should keep them in an overstock situation so that they would have to do something to get rid of the stock. Moreover, if they were overstocked with your products, they couldn’t do anything with a competitive product. Therefore, if you had an overstock on a product that was so far out of whack that they had to run a feature ad, you ended up moving a lot of stock, and the ad was a bonus to get customers to buy your product. Interesting paradox—in order to drive volume through the wholesaler warehouse, the more inefficient you made them, the better the overall volume would be.

So, guess what happened?

I did what every red-blooded vendor rep would have done. I put in over three months of unneeded, redundant inventory in the blink of an eye to make my year-end numbers. Heck, my management thought I was the greatest “buyer” of all time. I had made my numbers, and now all I needed to do was set up a whole bunch of ads, and the excess product would disappear. There was a flip side to this elation. I had betrayed Joanne’s trust. As a “real buyer,” I had dug myself a pretty deep hole. I knew I had screwed up badly, but I couldn’t figure out how to get rid of the excess inventory. It was time for me to go eat some of that long-deserved humble pie and have a meeting with the real buyer.

I had practiced the loaded buyer/happy buyer philosophy, but I wasn’t very happy.

She took it pretty calmly. Actually, she was much calmer than I would have been if some dumb guy like me had messed with my inventory. She told me that I had made the same mistake many first-time buyers make and I had put my personal needs ahead of her company. (*Ouch*, that one hurt.) She sat me down for the next hour and taught me the basics of *rule-of-thumb inventory management*.

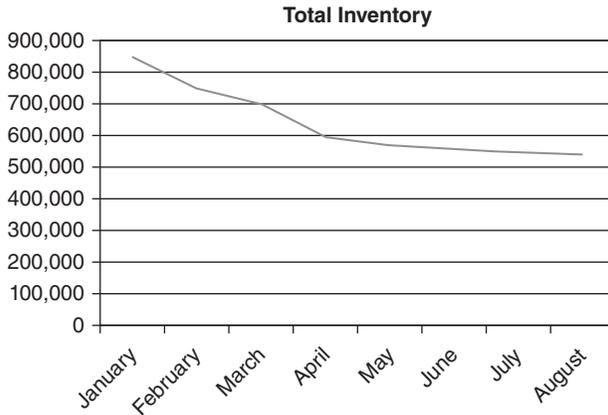
## **Rule-of-Thumb Inventory Replenishment Management circa 1985**

- If you have a lead time of a week, always have one week's supply for the demand and one week for the safety stock.
- Never buy more than five weeks' supply at a time, unless you have committed orders.
- If you have a subfeature ad, buy two weeks' supply.
- If you have a feature ad, buy four weeks' supply.
- Keep a close eye on products with pull dates.

I felt very conflicted as I left her office. Here was a seasoned buyer trusting me with \$5+ million in yearly sales. On one side, the supply-side mentality from my company's management thought I was the fox in the henhouse, but on the other side I could see there was a real art/science to this replenishment and inventory management. Nobody had ever told me about "pull supply chains," but I could see there was something to the idea of naturally pulling products through instead of making myself miserable with overstocks. I just had this feeling that I could really make a difference.

It took me close to two months to lower down the inventory through bleeding off the excess stock and minimizing the buying. During that time I spoke regularly with the advertising managers based at the wholesaler warehouse about their planning cycles and expected ad lifts from various advertising formats. They knew about my new role and took me under their wings. They must have seen the hangdog expression I had from doing the buying and gave me some pointers. They started me down the pathway of calculating lift, profitability, and basic rules of category management. I had a few items that were giving me fits from the lack of inventory bleed, and I talked a few of the ad guys into running some subfeatures to help me get rid of product. Once I got the inventory into a manageable level, as shown in Figure 1.1, I went back to Joanne to better understand the connection I needed to have between buying and advertising to pull product through.

If any of you out there have had to deal with a co-op wholesaler, you know there is little you can do besides being a merchandising conduit for the membership stores. You can certainly set up products



**Figure 1.1** Inventory Bleed-Off of Davis Product Portfolio

to be promoted, but there is very little influence brought to bear on ad price or display activity at the retail stores. The co-op wholesaler just does not have the retail clout that a chain store merchandiser might have. Given that downside, it was also the perfect test bed for a dumb, newbie buyer managing his own products. I learned, pretty fast, that oversupplying for limited demand was a recipe for disaster. I guess I needed to start acting like those big-boy chain stores and manage my demand.

Every quarter, I would attend a merchandising meeting with the brand managers from my company to plan out the promotion budgets. Up until that time, I would take what the brand managers felt I needed and present the packages to the ad managers at the accounts for the upcoming period. My normal acceptance rate was 50 to 60 percent, and I got so-so promotional lift and market share impacts from my merchandising. Well, now that I was a hotshot (and totally out of my league) buyer taking care of about 30 percent of the market volume, I just turned the tables on those brand managers.

Prior to my sitting down with the company brand managers, I went to each of the merchandising managers at the co-op wholesaler and discussed what I needed to do to plan out advertising on my key products. I had a pretty good stable of products, so I knew it was a win-win proposition. I didn't have any funds when I sat down with the merchandising managers, but we had an agreement that if we shook

on it, I would get them the ad funds and unit costs required to support the plan. Now I could sit down in these quarterly planning meetings with the brand managers and lay out complete merchandising packages they could take to the bank. It didn't take long for word to get out about the guy up in Portland who managed his own products with 30 percent of the market's volume.

Inside of six months after taking on the responsibility of my products, my overall volume had increased by almost 15 percent. Remember, this was after digging a three-month overstock hole in the first weeks of the fiscal year. That being said, there were two key performance indicators I was even more excited about, which my company's managers didn't understand. My inventory turns were up by almost 30 percent, and my out-of-stocks were down to less than 2 percent. I had a few bumps in getting those brand managers to commit, but I was doing much better with using my trade funds. I was now at an 88 percent acceptance rate, and the market share on my portfolio had gone from 30 percent to 32 percent.

Around this time I got my first offer (of three) to become a full-fledged buyer. You would not believe what a huge boost of confidence that gave me. I was getting the hang of this idea of pulling products through the system instead of practicing shoving the product through as most vendors in the grocery industry had practiced for 30 years. I turned down the offer as I felt I had a lot more to give as a vendor rep, and I was just having too much fun breaking the mold as this new-fangled vendor/buyer.

## MOVING TO A DEMAND-DRIVEN SUPPLY

The better I got at managing my portfolio at the co-op wholesaler, the more pressure I got from my managers to push product into the account. The weird thing was that after being so indoctrinated in the push mentality it was, suddenly, so easy to see through the faulty thinking.

Everything about a push supply chain has to do with what was described early in the chapter—make it inefficient by *packing somebody's pantry*. It didn't matter whose pantry, just pack it full. In essence, if you could create something so inefficient that you force someone

else to fix it to get rid of the product, you were successful. With that kind of thinking, you are not focused on customer needs. You are just thinking about your quarterly sales quota. I was amazed at the lengths some participants would go to create inefficient push supply chains.

The late 1980s were a tough time to be a brand-new vendor management inventory practitioner. Don't worry, though, I was laughing all the way to the bank. While all the others were trying to continue their ways of pushing product through, I was learning more and more about pulling product through catering to the customer's desires. It took 30 years for someone to put a name to what I was doing, but they now call it *demand-driven supply*.

I started looking into tweaking the inventory levels. Everyone was ratcheting down days of supply at the end of the quarter to make the numbers look better, but all I ever was able to do by practicing that was run out of stock on a boat-load of items. I couldn't keep the inventory down very long without a lot of grumbling by the retail store owners and managers. I was getting ready for a yearly business review (funny, I was going to give myself a business review of my own buying activities for the year, but I was going to be giving it to my buyer/mentor Joanne). I noticed a strange set of problems:

- Approximately 70 percent of my products were in a constant overstock situation when using the one week for demand and one week for safety stock rule-of-thumb calculation.
- About 20 percent of my products seemed to be understocked using the same rule.
- Advertised items tended to have a very high probability of being out of stock using the rule-of-thumb ad-buying process.
- My company had a problem supplying highly advertised products in stock during heavy promotional months. They did not have good visibility into the advertising support in the field until it was too late to react.
- The entire product portfolio was back-hauled by contractors to the co-op wholesaler, and therefore I was not responsible for the logistics. That being said, I did notice the back-haulers were delivering product anywhere between one and four days late on 30 to 40 percent of the shipment only needing two days' transit.

At the time I made my business review to “myself” (okay, Joanne was in the room, too.), I recommended that we shift our thinking on the rule-of-thumb inventory management techniques away from simple days of supply and begin to look at servicing the stores with a combination of demand, demand fluctuation, actual market data from Information Resources Incorporated (IRI), inventory costs, and logistics costs. Those recommendations came after I had just shown everyone that in the year I had been managing the product portfolio I had gotten inventory turns up to some of the highest in the account. My overall volume was up by 30 percent in Portland and 40 percent in Medford. According to IRI numbers, I had increased the market share of stores covered by the co-op wholesaler from 5 to 10 percent on my products.

I was ecstatic and wholeheartedly agreed with myself, but Joanne had some reservations. Allowing a vendor this kind of access to competitive information could, potentially, compromise the wholesaler’s market standing by allowing communication of ad events to other competitors. However, the advantage of upstream communications to my company would allow for better advertising performance on key items. It was decided that I would communicate long-term advertising schedules so that my company could gear up to support the ads I set with the accounts. My hope was this visibility to the lower level of the supply chain would give me better ad support.

## **CREATING MY ISLAND OF EFFICIENCY**

I was able to morph the simplified rule-of-thumb ordering processes to a forecast using IRI advertising lift information, coupled with a safety-stock add-on of one week’s average demand. Over time I used this projection to get to within a 5 percent accuracy of the actual volume. The process really helped in controlling the infamous 20 percent of the portfolio that was always in an understock mode. Products getting advertised created a far higher fluctuation in forecast confidence, and, at the time, we had no real way of focusing on that demand.

However, the overall rule-of-thumb process of keeping two weeks stock on hand was killing me. Whenever I tried to increase my store service level, my inventories soared. Conversely, when I was asked by

Joanne to lower the inventories at the end of a quarter, my out-of-stocks increased. If I stayed in the status quo, I could handle the overall inventory situation.

There was one other thing that was driving me crazy. My company was horrible in terms of providing consistent lead times and shipping complete orders, even though I was giving them much longer lead-time notice. I would call into our customer service representative and complain about orders showing up 3 days late from a distribution center only 500 miles away. In turn, Joanne would get calls from the customer service rep saying that products “a,” “b,” and “c” would be shorted and did she want to back order them? Joanne just took a message and gave it to me. Keeping a tight leash on inventories with a supplier noted for inconsistent delivery is a nightmare that I could not control.

This led me to a realization that no matter how hard I tried, in the present situation, I could only create efficiencies in my portfolio. I started to call myself the “island of efficiency.” In my own little world, I was able to bring inventories into a very lean position and increase my turns to the point of being in the top five of all portfolios, but no matter how hard I tried I couldn’t do any better because of the outside influences.

This put me into a position where 95 percent of all buyers in supply chains find themselves. First, we become prisoners of what we can see and the reactions to what we see. Depending on where you are in the supply chain, the vision is opaque. This is especially true the further up the chain you are from the original demand. In turn, the reaction is also blunted. At the end of the chain the reaction to the demand is all-important. This is why replenishment becomes so important at this point. Smaller inventory quantities and fluctuating demand can put a strain on you to react. Since the immediate upstream location does not know of the demand until you order, the reaction could be delayed or nonexistent. The human response is to couch your replenishment “bet” with extra inventory, just in case you have a supply disruption. If you have never seen this kind of supply chain reaction to barriered communications in a supply chain, I would strongly advise you to play the MIT Beer Game<sup>3</sup> to understand the effects of creating islands of efficiencies.

## WHAT IS AN ISLAND OF EFFICIENCY?

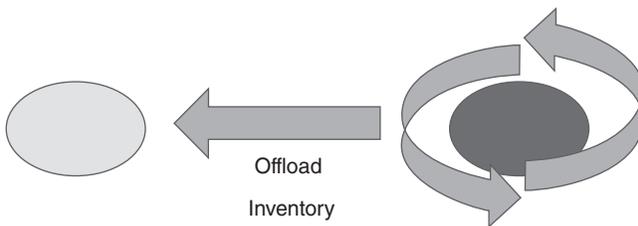
I have looked everywhere to find a generally accepted supply chain definition for the term *island of efficiency*. You see it everywhere in supply chains, but there is no simple explanation for the phenomenon. Given that state of affairs, let me take a stab at it.

### The Intended Island of Efficiency

We will review this, at length, later in the book, but the Kanban system developed by Toyota is a classic example of creating an island of efficiency (see Figure 1.2). Kanban is not an inventory control system. It is a scheduling system that enables users to determine what to produce, how to produce it, and how much to produce. However, the technique helps drive the inventory into position where it is delivered *just in time* for it to be used. In Kanban, inventory is evil. Therefore, the less you hold, the better. The key to Kanban that Toyota quickly learned is the ability to communicate outside of the island. If you didn't communicate, the lean inventories could be quickly eaten up by unforeseen activities.

In my role as a pseudo-VMI buyer I was practicing a lot of Kanban techniques to ensure the inventory could be held at a lean level, but that I would still have the ability to shift strategy when needed. Communication was everything, and the goal of the intended island of efficiency was to make sure my little link in the chain would work as effectively as possible.

As we will soon see, it cannot be overemphasized how the Toyota Kanban production efficiencies have influenced modern distribution supply chain techniques in the last 40 years—for better and for worse.

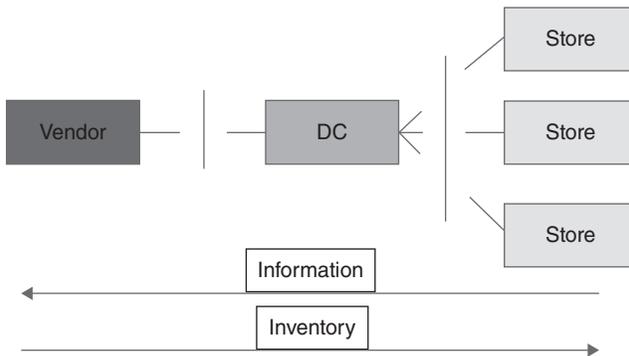


**Figure 1.2** The Kanban System

## The Unintended Island of Efficiency

In the intended island of efficiency, everyone working in their little link in the chain thinks they are pulling their own weight and effectively moving product to the final customer-facing location. As indicated in Figure 1.3, the arc data is severed so that very little immediate communication is actually propagated. What happens when there are barriers set up in technology that short-circuit the very best of human intentions and turn little links in the chain into what could best be described as inventory elephants on parade? Each chain link looks efficient, but when looked at as a whole, the supply chain takes on the appearance of bloated elephants. Each elephant is holding onto the tail of the one in front and blindly following the lead. More important, the further you get away from the initial customer demand, the more bloated the inventory gets. What would cause efficient links to turn into an inefficient chain? In almost every occurrence, it is a combination of technological shortcomings and human nature trying to correct it. In almost every instance human intervention was to create a bigger and faster replenishment process.

In essence, an unintended island of efficiency is created when (1) the downstream demand has been accumulated and presented as an aggregated total, (2) there is a delay in the initial demand from the original customer, (3) your service level need is an average, and (4) the upstream supply is expected to be at a 100 percent service level.



**Figure 1.3** Unintended Island of Efficiency

1. The downstream demand has been accumulated and presented as an aggregated total.

When demand is rolled up, the accumulated safety-stock calculations also get rolled up. This is the essence of the *bullwhip effect*. There will be larger and larger redundant stocks in place to cover this nonexistent demand variance.

2. There is a delay in the initial demand from the original customer.

If the demand used for the link in the supply chain is not the initial customer demand, there is a delay to accumulate the demand at the upstream location. This accumulation creates a distortion of time so the forecasted demand is less and less accurate—and late in arriving.

3. Your downstream service level need is an average.

Each downstream link in the chain might have a specific service level need, but there is little ability to discern differences between products and locations, so an average is used. You end up averaging to a small percentage of actually correct service level and leave the rest to fend for themselves.

4. The upstream supply is expected to be at a 100 percent service level.

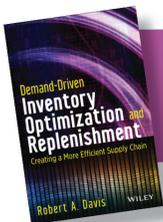
This is the bane of every buyer. Late shipments and/or incomplete shipments take up most of the time a buyer spends on tactical activities. The natural reaction is to hold more stock to cover for the event of less than 100 percent service level.

These four issues have created massive problems for companies as they have tried to move to a more demand-driven supply model. During the period from 1995 to 2005, companies used their newly purchased ERP systems to help counter the problems encountered with supply chain issues. In turn, when it was found that new and better processes needed to be put in place, SCM systems continued to build out functionality. The efforts to overcome these inventory problems were most often focused on the great equalizer of out-of-balance inventories: supersizing the replenishment system with better and better transactional rigor. In hindsight, were we just trying to make a better and better bandage? In reality, the focus might have been better spent looking at why the inventories were out of balance in the first place.

How did we get to this place where technically “advanced global supply chains have added upward of 30 percent higher inventories than needed and actually reduced overall service levels”?<sup>4</sup>

## NOTES

1. W. Yang, T. Felix, S. Chan, and V. Kumar, “Optimizing Replenishment Policies Using Genetic Algorithm for Single-Warehouse Multi-Retailer System,” *Expert Systems with Applications: An International Journal Archive* 39(3)(2012): 3081–3086.
2. Erik Kruse, “From Push to Pull—Perfecting the Means,” *Supply Chain Resource Cooperative*, September 4, 2003, <http://scm.ncsu.edu/scm-articles/article/from-push-to-pull-perfecting-the-means>.
3. MIT Beer Game. This game enables game players to simulate supply chain decisions.
4. Kruse, “From Push to Pull—Perfecting the Means.”



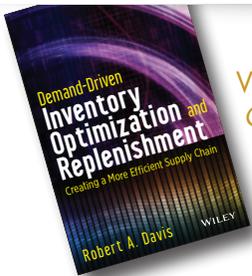
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