Predictive Analytics for Inventory in a Sporting Goods Organization

by

Marie Wolbert

B.S. Mechanical Engineering
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Submitted to the MIT Sloan School of Management and the Engineering Systems Division in Partial Fulfillment of the Requirements for the Degrees of

Master of Business Administration
and
Master of Science in Mechanical Engineering

In conjunction with the Leaders for Global Operations Program at the Massachusetts Institute of Technology

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Signature of Author ______________________
Mechanical Engineering, MIT Sloan School of Management
May 10, 2013

Certified by ______________________
Stephen Graves, Thesis Supervisor
Professor, Management Science

Certified by ______________________
David Simchi-Levi, Thesis Supervisor
Professor, Engineering Systems Division

Certified by ______________________
David Hardt, Thesis Reader
Professor, Mechanical Engineering

Accepted by ______________________
David Hardt, Chairman, Committee on Graduate Students
Department of Mechanical Engineering

Accepted by ______________________
Maura Herson, Director of ~~MIT~~ Sloan MBA Program
MIT Sloan School of Management

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Abstract

Inventory management for retail companies has become increasingly more important in recent years as competition grows and new supply chain models are implemented. Inventory levels have implications on not only the financial side of the business, but also on brand perception in the marketplace. Because of the impact of inventory levels on the external perception of Nike's overall financial performance, inventory management continues to be a high priority for the most senior leaders at Nike. The average DSI (Days of Sales in Inventory) has not dramatically changed overall from 2007 to 2012. While the business has made great strides in inventory efficiency (turnover) overall, that efficiency is offset by structural changes in the geography mix, product engine mix, business model mix, channel mix, and manufacturing locations.

Nike would like to understand the impact of the structural changes and determine future levels of inventory. The objective of this project is to determine future levels of inventory based on business growth variables as well as optimal levels based on value creation opportunities. This will enable Nike Supply Chain to effectively prioritize improvement opportunities and project the proper inventory levels to stakeholders.

The key research objective includes creating a forward-looking model to better understand the structural elements of inventory and the related drivers to each one of those. This model gives Nike the ability to perform scenario planning analysis and quantify value opportunities to determine target levels of inventory, considering different variables of Nike business such as strategies in retail, merchandising, sourcing / manufacturing and sales. Finally, this enables the company to have a standardized process across business geographies and incorporate them into supply chain management cycles already in place. More specifically, this research has proven that the MTS (made-to-stock) inventory order type is becoming increasingly more important to Nike's business. It is essential for Nike to begin tracking this order type at a higher granularity to truly understand future business levers to pull for each geography and product engine.

Thesis Supervisor: Stephen Graves
Title: Professor, Management Science

Thesis Supervisor: David Simchi-Levi
Title: Professor, Engineering Systems Division

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1 Introduction

Nike is an industry leader in supply chain (according to Gartner's 2012 rankings, Nike ranked 14th [1]), in large part due to its excellence in inventory management. While the business has made great strides in supply chain efficiency overall, that efficiency has been offset by structural changes in the geography mix, product engine mix, business model mix, channel mix, and manufacturing location. DSI (Days of Sales in Inventory) is a major indicator to the health of the business; therefore, Nike would like to better understand the impact of these structural changes and determine future levels of inventory.

1.1 Project Objective

The objective of this project is to use analytics to predict Nike's future inventory positions, understand where the company should focus their efforts to decrease DSI, and determine the payoff of the focused efforts. Overall, Nike would like to move from intuition-based decision-making and problem solving to data-driven decision-making and problem solving. The global inventory model enables Nike Supply Chain to effectively prioritize improvement opportunities and project the proper inventory levels to stakeholders.

1.2 Company Background

Headquartered in Beaverton, Oregon, Nike, Inc. is the world's leading innovator in athletic footwear, apparel, equipment and accessories [2]. The company is named after the Greek goddess of victory and markets its products under its own brand, as well as Nike Golf, Nike Pro, Nike+, Air Jordan, Nike Skateboarding, and subsidiaries including Cole Haan, Hurley International, Umbro and Converse. Nike previously owned Bauer Hockey (later renamed Nike Bauer) between 1995 and 2008. However, the company announced on May 31, 2012 its intention to sell both Cole Haan and Umbro. One of the most recognizable symbols of the brand is the "Swoosh," which was designed by Carolyn Davidson, a Portland

State University graphic design student at the time. The company lives, breathes, and makes every decision with the following mission in mind:

TO BRING INSPIRATION AND INNOVATION TO EVERY ATHLETE* IN THE WORLD

*IF YOU HAVE A BODY, YOU ARE AN ATHLETE

Figure 1. Nike, Inc. Mission Statement.

Nike attributes much of the company's success to its heritage. The company was founded as Blue Ribbon Sports by Bill Bowerman, a true innovator and nationally respected University of Oregon track and field coach, and Phil Knight, a former Bowerman middle-distance runner with an MBA in finance from Stanford University. In January 1964, the two founders paid $500 and placed an initial order of 300 pairs of shoes from the manufacturer of Tiger shoes, Onitsuka Co.

The third employee, Jeff Johnson, was hired in 1965 and is considered instrumental to Nike as a brand. He established a mail-order system, opened the first retail store, and managed Nike's entire supply chain at that time. He is also credited for creating brochures, ads, and even photographs for the company. It was at this time that Nike decided to break from Onitsuka to manufacture their own brand.

Nike's new footwear debuted in 1972, before the U.S. Track & Field Trails in Eugene, Oregon. Bowerman's waffle iron outsole innovation was a huge hit, being lighter than traditional running shoes. Around this time, Steve Prefontaine became the face of the Nike brand. His competitive spirit and drive live within Nike; Phil Knight believes that Pre is the "soul of Nike."

Nike successfully launched the Nike Air technology in the 1980s, and by the end of the decade completed its IPO and became a publicly traded company. It was during this time that Nike debuted a new shoe for NBA rookie Michael Jordan. In 1987, Nike launched Air Max, where the Nike Air bags could be seen. One of the more famous TV ads using the original Beatles' recording of "Revolution" launched in conjunction with these shoes. One year later, ads using the "Just do it" tagline and the two-sport athlete Bo Jackson continued the expansion of Nike's reach to become the world's largest athletic retailer.

1.2.1 Nike Better World

Nike's environmental campaign is Nike Better World and its mission is "Making the world better through sport; serving the needs of the athletes and the planet at the same time." For 2011, Nike doubled the use of recycled polyester in apparel. The equivalent of 440 million discarded PET plastic bottles were saved and given new purpose because of Nike [3]. According to the New England-based environmental organization Clean Air-Cool Planet, Nike ranks among the top three companies (out of 56) in a survey of climate-friendly companies [4].

Nike has also been praised for its Nike Grind and Reuse-A-Shoe programs, which closes the product lifecycle [5]. Launched in 1993, it is Nike's longest-running program that benefits both the environment and the community by collecting old athletic shoes of any type in order to process and recycle them. The material that is produced is then used to help create sports surfaces such as basketball courts, running tracks, and playgrounds.

1.2.2 Nike Supply Chain

Nike supply chain's mantras are "Right product, Right place, Right time, Right cost" and "winning at the moment of truth." Working towards these customer-focused goals ensures that Nike supply chain is focused on service and delivery. Nike believes that optimizing service, inventory and cost through cross-functional alignment maintains supply chain balance. This management focus is shown in Figure 2.

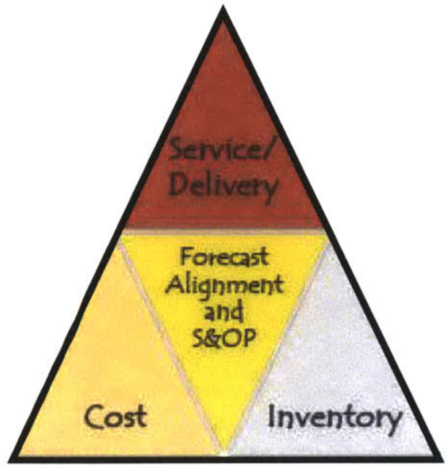

Figure 2. Supply Chain Management Focus.

Overall, Nike has 500,000 SKUs, and produces approximately 1 billion units per year. The company has 57 worldwide distribution centers and sells Nike product in approximately 100,000 retail outlets. A majority of North America product is sold in independent retailers such as Dick's sporting goods and Sports Authority.

1.2.3 Nike Manufacturing

Nike is required to disclose efforts to eradicate slavery and human trafficking from the company's supply chains according to The California Transparency in Supply Chains Act [6]. According to their manufacturing section on their website, Nike watches from the first phase of product creation to the impacts of decisions on the lives of workers in the factories [7]. The company has built an interactive map to inform audiences about Nike, Inc. global manufacturing. According to the map, as of December 2012, Nike manufactures in 43 countries, at 841 factories that employ 1,060,633 workers. With the exception of the Nike Air bag technology, all manufacturing is done by contract manufacturing; therefore, Nike does not own any offshore factories. Most of the factories are located in Asia, including Indonesia, China, Taiwan, India, Thailand, Vietnam, Pakistan, Philippines, and Malaysia. This map also indicates the percent female, migrant, manufacturing profile, and average age, all to bring more transparency to their sourcing strategy.

2 Literature and Supply Chain Model Review

In numerous organizations, there are two interacting chains: 1. The supply chain or the flow of products from suppliers to retail stores and customers via manufacturing and distribution centers and 2. The development chain or the new product introduction focusing on product suppliers, partners, footprint, supply contracts, and make/buy decisions. Typically, the two chains are run by different managers who focus on his or her objectives and responsibilities without concern for the impact on the other portion of the chain. The supply chain is characterized by demand uncertainty and variability, economies of scale, and lead-time, while the development chain is focused on technology clockspeed, make/buy decisions, and product structure [9]. It is obvious that the key characteristics of the major company product lines have major impact on the supply chain strategy a company should use. Although this thesis is focused mainly on supply chain, it is important to note how the development chain influences the supply chain strategy.

Figure 3 depicts the impact of demand uncertainty and product introduction frequency on product design and supply chain strategy [9]. Higher demand uncertainty leads to a preference for managing the supply chain based on a pull strategy, while smaller demand uncertainty leads to managing with a push strategy. Furthermore, high product introduction frequency (fast clockspeed) leads to a focus on modular product architecture to postpone product differentiation, even sometimes until demand is realized. Similarly, product postponement is not as important when product introduction frequency is low [9]. Most of Nike product lies in box B, which represents products with fast clockspeed and highly unpredictable demand. Therefore, the supply chain strategy should focus on responsiveness or on a pull strategy and having a modular product architecture. However, some of Nike's items, which are labeled as "Rapid Response" product have longer product lifecycles with more predictable demand. This would fall in box A instead, and these products should use more of a push strategy supply chain, focusing on high inventory turns and efficiency.

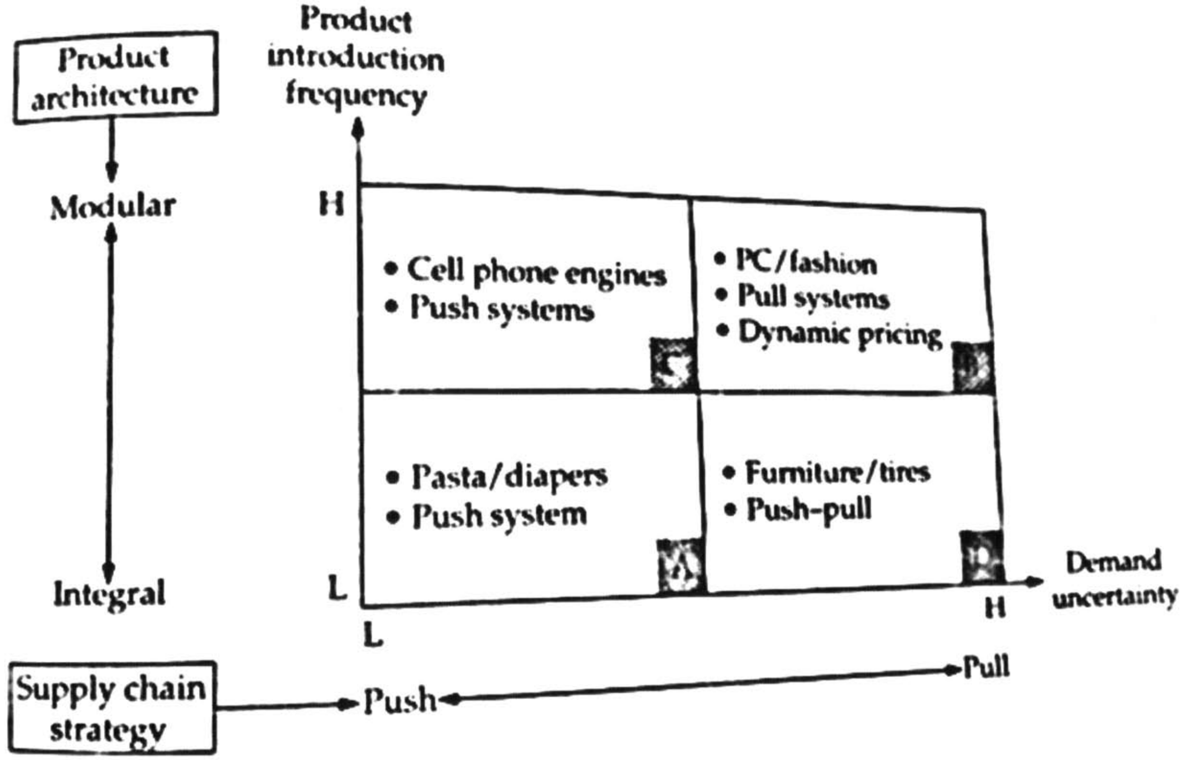

Figure 3. The impact of demand uncertainty and product introduction frequency on product architecture and supply chain strategy.

Similarly, supply chain architecture must also be based on proximity, meaning the following four dimensions: geographic, organizational, cultural, and electrical. Geographic proximity is measured purely by the physical distance of the source versus the customers [10]. This is becoming increasingly important at Nike as Latin countries within Emerging Markets, much farther from the source base grow faster than any other geography, including China. Organizational proximity is measured by managerial control, cultural proximity captures commonality of language, ethics, etc, and electronic proximity is captured through email, video conferencing, etc [10]. Today, much of Nike's manufacturing is located in Asia, while customers are all over the world. The employees making the buys for each geography are located in their specific geography or territory for the case of Emerging Markets.

2.1 Inventory Management Research

In recent years, Nike has added new and more complex supply chain models to their system in order to combat growing competition in addition to being able to handle the NFL demand after taking over its contract. With the growing complexity, Nike has been expanding their tool box and has attracted some of the brightest talent in the supply chain and operations fields. However, a large percent of product is made-to-order and focused on a pull supply chain strategy. This section regarding forecasting research applies to the newer models. Although the Newsvendor and EOQ models were not used in this project, it is recommended for deep dives specifically for make-to-stock inventory types.

2.1.1 Forecasting Research

Newsvendor Problem

The newsvendor model is used to determine optimal inventory levels. It deals with understanding how much product to produce at any given time. As in a newspaper vendor, the tradeoff is having too much inventory that is worthless at the end of the day or too little that resulted in missed sales.

As expected, the underage cost or cost of having too little inventory is not the same as overage cost or cost of having too much inventory. In most businesses, the lost revenue from not having a unit in stock is greater than the overage cost. Taking overage and underage costs into consideration, it is possible to understand the quantity that minimizes the cost of having too little or too much inventory [8].

To determine the order quantity that minimizes this cost, on can use the expected profit equation as follows:

$$\Pi = \begin{cases} q(r-p) & if\ d > q \\ dr + (q-d)s - qp & if\ d \leq q \end{cases}$$

where,

p = unit production cost

r = unit revenue

s = unit salvage value

d = demand (unknown)

q = order quantity

Based on this profit function, one can write the expected additional profit from ordering one extra unit. This is useful since the optimal order quantity is that for which this function equals zero:

$$\frac{d\Pi}{dq} = \mathbb{P}(d > q)(r - p) + \mathbb{P}(d \leq q)(s - p) = 0$$

$$\mathbb{P}(d \leq q)(s - p) = \mathbb{P}(d > q)(r - p)$$

$$\mathbb{P}(s - p) = -(1 - \mathbb{P}(d \leq q))(r - p)$$

$$\mathbb{P}(s - p) = -(r - p) + \mathbb{P}(d \leq q))(r - p)$$

$$\mathbb{P}((s - p) - (r - p)) = -(r - p)$$

$$\mathbb{P}(d \leq q) = \frac{r - p}{(r - p) - (s - p)}$$

However, $r - p$ and $p - s$ (or as shown in the equation $-(s - p))$ are equivalent to underage and overage costs, respectively. Therefore, the optimal order quantity meets the following:

$$\mathbb{P}(d \leq q) = \frac{c}{c + h}$$

Economic Order Quantity Model

Another method for determining the optimal order quantity is the economic order quantity model (EOQ). Similar to the newsvendor model, the EOQ is a tradeoff between ordering too much or too little inventory, but the cost logic is different. The cost of ordering too little inventory in the EOQ model is having to order more inventory frequently. This affects shipping and set-up charges. The cost of ordering too much is a high average inventory, leading to higher opportunity and holding costs [11].

The EOQ model is designed for situations when demand is known and constant and orders are repeated. Also, there is a fixed cost per order, the inventory holding cost is known, and the replenishment of inventory is assumed to be immediate [11]. Total inventory cost is as follows:

$$C = s\left(\frac{d}{q}\right) + ck\left(\frac{q}{2}\right)$$

where,

s = cost per order (e.g. shipping and setup costs)

k = inventory holding cost

c = product unit cost

d = demand rate (known)

q = order quantity

Note that the first term on the right side of the equation is the total ordering costs and the second term is the inventory holding costs. This is because when demand is known, there are no costs related to lost sales or too much inventory. Finding the order quantity that minimizes the total cost is determined by setting the derivative equal to zero and solving for q:

$$\frac{dC}{dq} = -\frac{sd}{q^2} + \frac{ck}{2} = 0$$

Therefore,

$$\frac{ck}{2} = \frac{sd}{q^2}$$

$$q^2 = 2\frac{sd}{ck}$$

$$q = \sqrt{\frac{2sd}{ck}}$$

The EOQ deals directly with the notion of repeated ordering for inventory replenishment and inventory holding costs, whereas the newsvendor does not as it assumes only one period. However, the EOQ is very limited as it requires demand to be both known and constant [11]. At Nike, most of the product is made-to-order. As Nike begins to transition more products to a make-to-stock strategy, these models become increasingly more important. One major issue, however, is how uncertain demand tends to be for new innovative product launches.

3 Project Methodology

3.1 Nike Supply Chain

Nike manufacturers nearly all of its product using contract manufacturers in Asia. Raw materials are sourced from suppliers and incorporated into the final assembly of footwear, apparel, and equipment in factories throughout Asia. The consolidator is a warehouse located in Asia that is used to repack and store inventory prior to shipping it to its final destination. The consolidator is located within the supply chain directly after the final assembly factory and before the in-transit and Nike distribution center (DC) locations. This is shown in Figure 4.

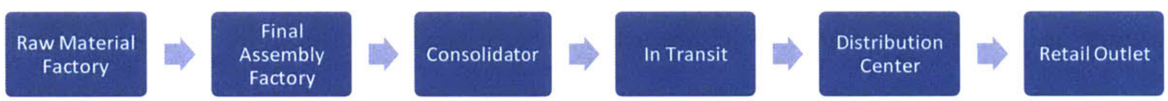

Figure 4. Nike Supply Chain Inventory Locations

The Global Inventory Model considers all finished goods inventory from the consolidator to the distribution center. At any given point in time, finished goods may be held in several locations as well as within the DC as specified inventory types. For the purposes of this model, inventory is segmented as follows:

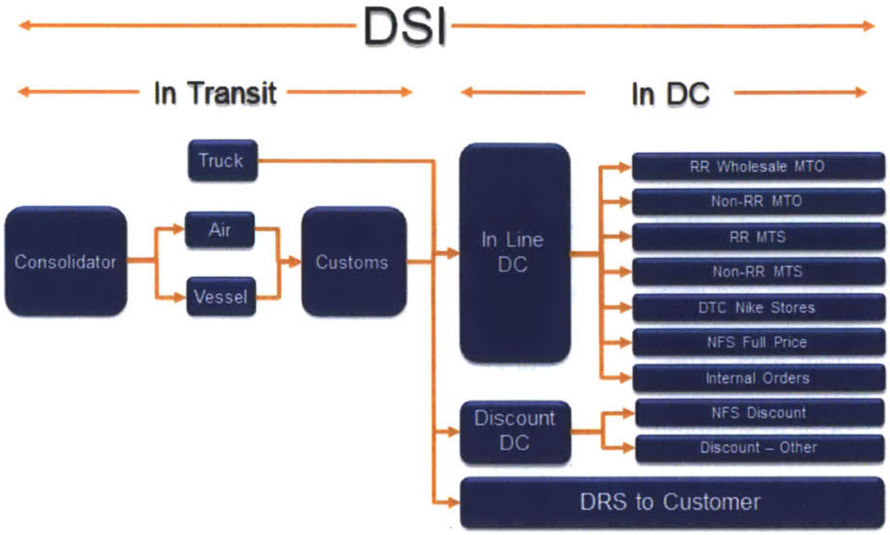

Figure 5. Inventory Segmentation.

DRS to customer is product shipped directly to the customer, bypassing the DC entirely. In line product is considered full priced product, while discount product is considered off price product that is sold at a discount. The inventory within the DC is separated not only by inventory type, but also by channel and supply chain model. RR stands for Rapid Response, which is Nike's popular product intended to be placed on a make-to-stock supply chain model; however, some of this product is actually made-to-order and considered "Rapid Response MTO." Table 1 explains the major differences in inventory

Table 1. Inventory Segments Explained.

Inventory Segment	Explanation
RR Wholesale MTO	Wholesale fully priced made-to-order product on the RR supply chain model
Non-RR MTO	Wholesale fully priced made-to-order product not on the RR supply chain model
RR MTS	Wholesale fully priced made-to-stock product on the RR supply chain model
Non-RR MTS	Wholesale fully priced made-to-stock product not on the RR supply chain model
DTC Nike Stores	Fully priced product being sold in Nike brick and mortar stores (excluding Nike Factory Stores)
NFS Full Price	Fully priced product being sold in Nike Factory Stores
Internal Orders	Product on contract with specific customers that is held at the DC. This product is released into MTS product if the contract expires or is cancelled.
NFS Discount	Off priced product sold through Nike Factory Stores
Discount – other	Off priced product sold through other retailers such as Ross and TJ Maxx

In addition to the inventory segments in Figure 5, finished goods inventory is separated by product engine and geography. In other words, the model considers apparel, footwear, and equipment separately for each of the geographies. The following geographies are modeled:

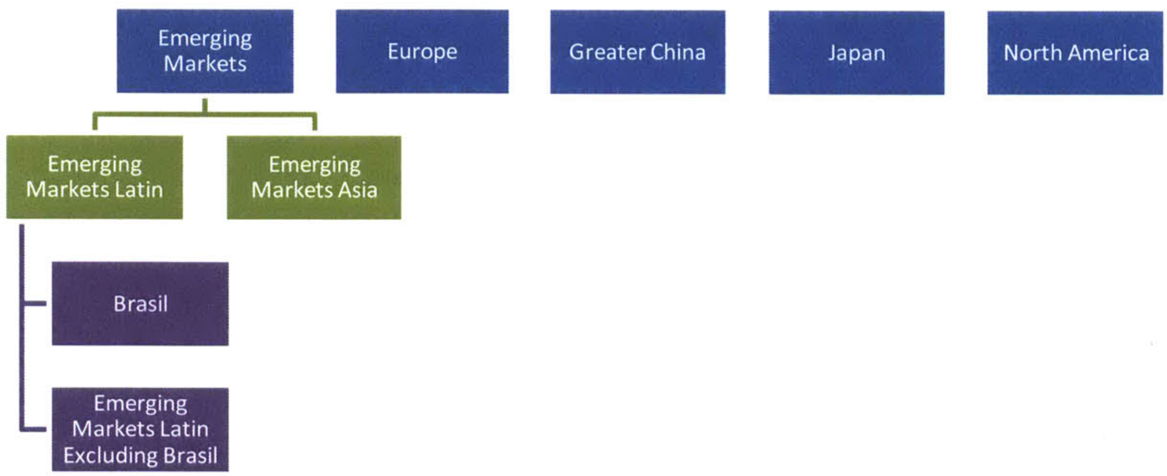

Figure 6. Geographies Modeled in Global Inventory Model.

3.2 Model Approach

Overall, the model was built by collecting data and information from several teams throughout the world. Demand planning & Inventory Management (DP/IM) managers for each geography were instrumental in obtaining inventory information at the necessary granularity. Other teams included Supply Chain & Integrated Planning (S&OP), Network Strategy, Finance, and Logistics.

The model was created in five major steps. These steps include mapping the current state of inventory, building the model using inputs from the various teams, validating the inventory against historic data, prioritizing value opportunities, and developing inventory projections until 2020.

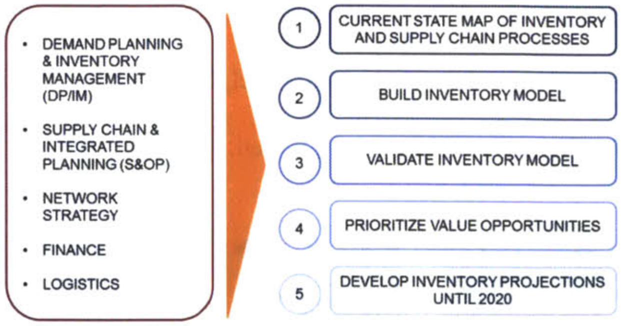

Figure 7. Global Inventory Model Five-Step Approach.

The Global Inventory Model methodology is summarized in Figure 8. Historic data such as inventory levels and shipments are input into the model to calculate units, DSI, and turns. Business levers are used to project levels until 2020. Changing the business variables makes the model dynamic and useful for scenario planning. Further detailed explanation of the model is located in Appendices A and B.

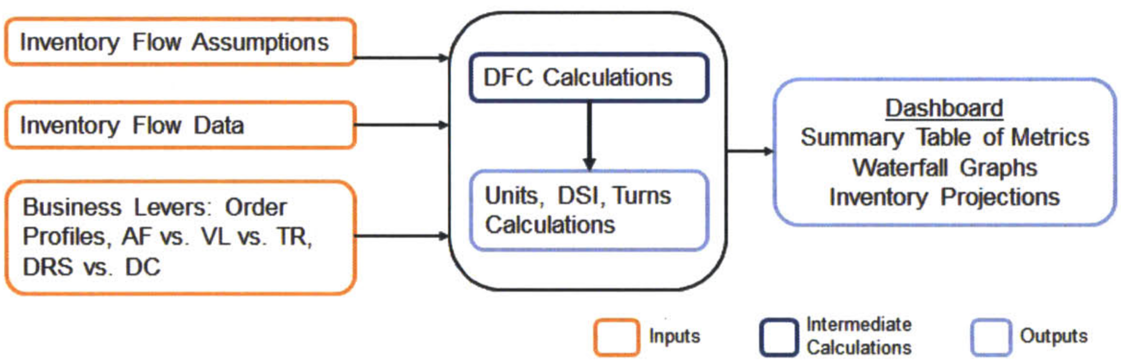

Figure 8. Global Inventory Model Methodology.

3.3 Detailed Model Description

The Nike Global Inventory Model is based on the Days of Forward Coverage (DFC), or the days of inventory needed to cover the next sales period worth of demand (shipments). As shown in Figure 9 below, the DFC consists of the build, hold and out days. Build days are the number of days over which to process a sales period (one month in this model) worth of receipts, while the hold days are considered the buffer or safety stock, and the out days are the number of days over which to process a sales period worth of shipments. Given that inventory is assumed to be taken from the consolidator and placed on a vessel, air plane, or truck immediately, the build and out days for in transit pieces are not considered. However, inventory for a given month may build or ship over several days within a DC; therefore, build and out days are considered. In these cases, it is assumed that inventory builds into and ships out of the DC at a constant rate, so a straight line approximation is used.

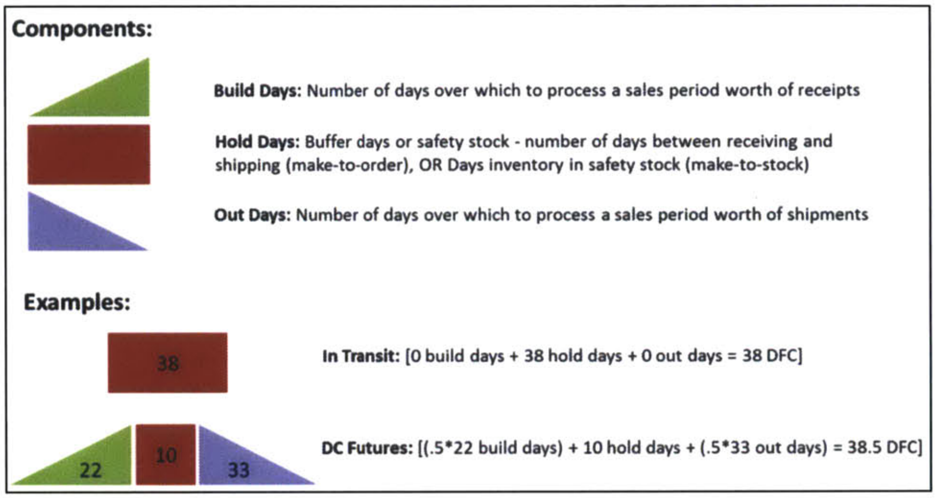

Figure 9. DFC Concept Explanation.

The structural limit, actual, and optimal DFC is calculated for each inventory segment. The structural limit DFC is the minimum number of days possible for build, hold, and out assuming a complete flow through supply chain. The actual DFC is the current actual number of days for the build, hold and out, while the optimal DFC is the minimum number of days possible driven by supply chain improvements for build hold and out. The difference between the structural limit and the optimal DFC is that the structural limit assumes 100% efficiency throughout the entire supply chain, while the optimal DFC is an attainable target number between the structural limit and actual DFC, considering hold time variability. For the purposes of the model, the actual DFC was first calculated using historical data of inventory levels and daily shipments. Inventory units is defined as the average inventory level over a given year. The formula is as follows:

$$DFC = \frac{inventory\ units}{FY13\ shipments\ total} \times 365\ days \qquad \text{Eqn. 1}$$

The structural limit was calculated using minimum transit times by mode of transit and through conversations with inventory managers at the DC to understand the fastest rate at which inventory could possibly move through the warehouse given processing times, etc. The optimal DFC was also determined through conversations with inventory and inbound logistics managers to understand areas of improvement. These improvements were quantified using a percentage increase in efficiency and applied to the actual DFC values.

Once the DFC numbers are determined for each inventory segment and each product engine, shipment information is used to develop a forecast of the inventory units, DSI by inventory segment, total DSI for a product engine, and turns, as it depends on a forecast of future shipments or demand. Inventory units for a month are forecasted by multiplying the DFC by the average daily shipments:

$$inventory\ units\ = DFC \cdot \frac{monthly\ shipments\ total}{number\ of\ days\ in\ month} \qquad \text{Eqn. 2}$$

The DSI by inventory segment is determined by dividing the inventory units for a specific segment by the average daily shipments of the given fiscal year for that inventory type only. The total DSI is determined by dividing the inventory units by the total average daily shipments of a given fiscal year and adding all inventory segments together. The model also separates in transit DSI by adding the total DSI from the in transit portions; the DC DSI is determined by adding the total DSI from the inventory segments within the DC only. Turns are calculated by dividing the total DSI by 365. This methodology is applied for both the structural limit and optimal level inventory units, DSI, and turns calculations by using the DFC value for that level.

In addition to determining the current year structural limit, actual, and optimal information, the model is able to predict future inventory positions using business levers for every year until 2020. These business levers include growth percentages by inventory segment, improvement assumptions by inventory segment, and changes to air, vessel, and truck transportation percentages. The growth percentages are the expected increases in demand determined by financial growth projections and targets as well as through discussions with inventory managers. The shipments forecasts for the next year are determined by adding the growth percentage to one and multiplying by the previous year's shipments for each inventory segment:

$$shipments_{FY14} = (\%growth_{FY14} + 1) \cdot shipments_{FY13} \qquad \text{Eqn. 3}$$

On the other hand, improvement assumptions model supply chain efficiency increases. These values are determined by quantifying a percentage for specific value creation opptortunities that can not be implemented immediately. For example, changing inventory flows to be able to introducc 60% of total prodcut for a season in the first month, 30% in the second month, and 10% in the third month may not happen immediately. Therefore, the improvement assumptions allow the user to assume that this action will take place in a later year (e.g. 2016), and the efficiency increase will be applied from 2016 to 2020.

Finally, the air / vessel / truck percentage splits are also applied to the shipment portions of the predictive part of the model. If more inventory is planned on being trucked to the DC (assuming local production), a lower percentage of shipments will be transported by air or vessel.

Once all of the business levers have been applied to shipment and inventory numbers until 2020, the DSI by segment, total DSI, and turns are calculated in the same fashion as the current state numbers. The structurual limit, actual, and optimal DFCs are multiplied by the shipment numbers to obtain a forecast of inventory units, while the daily average shipments in a given year by inventory type and total are divided to obtain DSI numbers. Once again, 365 divided by total DSI represents the expected turns until 2020. This methodology is performed for each product engine and geographies listed in Figure 6.

One example of a scenario considered for this model is the local manufacturing of footwear in Brazil. Currently, approximately 31% of all Nike footwear sold in Brazil is manufactured locally and transported via truck to the Brazil DC. If this percentage of footwear manufactured locally doubled by 2016, this would cause a decrease in Brazil overall DSI by 12 days, an overall Emerging Markets DSI dcrease of 3 days, and a Nike DSI decrease as well. The overall Nike decrase is not revealed for confidentiality purposes. This is determined through the use of the model by changing the percent truck transit in 2016 under the business levers tab. Other scenarios that could be considered are the changes in growth predictions in China versus Nike's Emerging Markets geography or the changes in Rapid Response product growth.

4 Model Attributes and Functionality

The Nike Global Inventory Model allows a "best of breed" process to be implemented at Nike. By creating a standardized way of comparing inventory levels for all geographies, the company can create a knowledge sharing practice. This allows less developed countries without the Rapid Response supply chain model implemented or countries with long transit times to be able to properly compare their supply chain efficiency to other geographies. Outliers uncover best practices or issues within Nike's supply chain.

One of the major outputs of the model is a comparison of the various inventory levels by geography and inventory segment. Figure 10 shows an example of the current total DSI by inventory segment and geography. Note that all data has been scaled appropriately to maintain confidentiality. Currently, Nike reports total inventory levels to Wall Street. Inventory levels by geography and by inventory type are not disclosed to the public; however, they are tracked by product engine, but not by this granularity of inventory segment.

	Consolidator	Air	Vessel	Truck	Customs	DRS	RR MTO	Non-RR MTO	RR MTS	Non-RR MTS	DTC Nike Stores	NFS Full Price	Internal Orders	NFS Discount	Discount - Other
NA	1.2	0.5	2.9		0.1	1.3	5.5	5.2	5.6	15	5.1	3.9	8.7	5.3	4.6
EU	0.6	0.3	3.4	0.3	0.5	1.3	4.6	3.1	13	16	6.6	8.2	13	16	14
GC	1	0.3	1.1	0.3	0.6	1.0	2.2	2.6	32	11	6.6	16	7.8	14	17
JPN	0.9	0.1	0.8	0.5	0.4	0.9	8.8	6.4	8.7	9.2		2.1			7.1
EM Asia	1	0.1	0.8	0.3	1	1		2.4		24	3.4	18	24		25
EM Latin - BRZ	0.9	0.3	3.3	0.7	2.5	5	1.6	4.3		11		9.6	12		23
BRZ	1.8	0.6	3.4	0.6	2.1			5.4		10				9.3	9.7

Figure 10. Total Inventory Component Comparison by Geography.

The left hand side of the scorecard in Figure 10 lists all of the geographies modeled, while the columns represent the inventory segments. The numbers listed in each box indicate the average DSI for that inventory segment. The information above is for 2012; however, these numbers can be output for every year until 2020. Furthermore, the green highlight represents the "best in class" or the lowest DSI for that inventory segment, while the red represents the lowest performer. Grey boxes indicate a lack of data or even the lack of inventory segment for the specific geography. For example, Brazil had yet to implement the Rapid Response supply chain model.

The power of scorecards from the model comes from the ability to compare all geographies using a consistent method. Often times, geographies located far from the source base blame their high inventory levels on long transit times. Removing transit time and comparing inventory only in the DC allows for an even comparison. Furthermore, certain countries with the Rapid Response supply chain model often attribute higher inventory levels to the more sophisticated model that tends to carry more inventory. However, comparing apples to apples throughout the finished goods supply chain has proven to have interesting insights for Nike.

In addition, this model has discovered Nike's greatest drivers of inventory through several sensitivity analyses. The sensitivity analysis entails running individual cases for each inventory segment within each product engine. To understand the greatest drivers of inventory, the DFC for each segment is manually decreased by 50% of its current state value and the change to both the geography and Nike overall is documented. As expected, North America and Europe geographies are the greatest drivers of Nike Brand inventory. Apparel tends to drive inventory more than Footwear and Equipment, while Non-RR MTO tends to drive inventory more than any other inventory order type and supply chain model. However, surprises include Europe *Rapid Response MTS* apparel as a large driver of overall Nike inventory and *Discount* apparel intended for Nike Factory Stores as a huge driver of China inventory. Table 2 below lists the largest drivers for Nike Brand and for each geography.

Table 2. Largest Inventory Drivers.

Geography	Largest Inventory Drivers
Nike Brand	• North America Apparel Non-RR MTO • North America Apparel Non-RR MTS • Europe Apparel RR MTS
North America	• Apparel Non-RR MTO • Apparel Non-RR MTS • Footwear Non-RR
Europe	• Apparel Non-RR MTO • Apparel Non-RR MTS • Footwear Non-RR MTO
Emerging Markets	• Apparel Non-RR MTO • Footwear Non-RR MTO • Equipment Non-RR MTO
Greater China	• Apparel Non-RR MTO • Apparel NFS Discount • Footwear Non-RR MTO
Japan	• Apparel Non-RR MTO • Apparel Discount – Other • Footwear Non-RR MTO

4.1 Current State Analysis

4.1.1 Model Validation

The current state analysis is performed initially to validate the model. The model was validated for each geography using the 2012 fiscal year (June 2011 to May 2012). The theoretically modeled inventory levels were all within 6% for all the geographies. North America and China were within 3%. It is interesting to note that the model resulted in slightly higher inventory numbers for North America, but slightly lower for Europe. This is due to the various best available sources of data for each country country. Having a consistent data source for all information would minimize the fluctuations between countries for future iterations. Table 3 shows the rest of the percent differences for the geographies by product engine.

Table 3. Inventory Level Percent Difference between FY2012 Actual Data and the Model Result.

Geography	Product Engine	% Difference
North America	Apparel	3.2%
	Footwear	0.6%
	Equipment	2.3%
Europe	Apparel	-5.3%
	Footwear	-1.7%
	Equipment	-5.3%
Emerging Markets	Apparel	-5.0%
	Footwear	-0.6%
	Equipment	-6.0%
Greater China	Apparel	3.0%
	Footwear	1.7%
	Equipment	-2.9%
Japan	Apparel	3.4%
	Footwear	5.2%
	Equipment	-2.4%

4.1.2 Current State Projections

The current state analysis is also used to project Nike's future inventory levels assuming no efficiency changes are made to the various inventory segments within each geography. These projections are made using business growth variables taken from current financial projections. In this case, the projected shipments are multiplied by the business year over year growth variable as explained in Appendix A. In other words, if a segment with a larger DSI is (e.g. Rapid Response MTS) grows at a faster rate than a lower DSI segment (Non-Rapid Response MTO), the overall expected DSI will trend upwards in the future. Figure 11 below shows the major output of the Nike Global Inventory model. Note the scale has been hidden for confidentiality. Furthermore, waterfall graphs showing increases in specific segments are given in the example in Appendix A under the Outputs section.

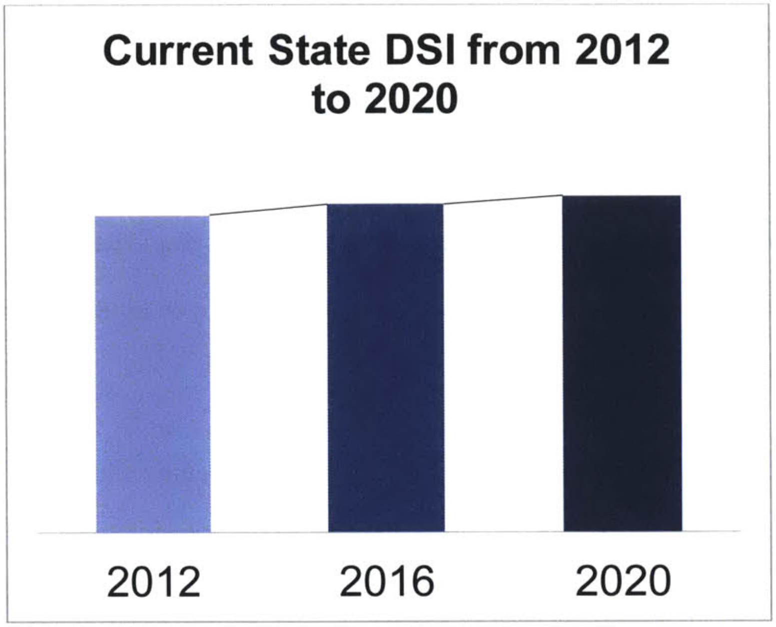

Figure 11. Current State DSI from 2012 to 2020.

4.2 Target State Analysis

The Target State Analysis was performed for each geography. Once the current state was validated and sensitivities for each geography were run, opportunities were determined through conversations with each geographic team. A best of breed process was also crucial during this time, as it allowed the teams to ask questions as to how certain geographies were able to have lower DSI numbers for specific segments. It also uncovered specific areas certain geographies needed to concentrate on and began several discussions specific to tracking MTS inventory more closely.

Target DSI numbers for each inventory segment were determined with the help of inventory managers within each location. Based on specific improvements to their operations, we determined a new DSI for each segment from the percent increase in efficiency they expected from the value opportunity.

4.3 Growth Rate Basis and Improvement Functionality

Growth rates were taken from several strategy sources. Financial projections were used for MTO product inventory, while DTC (Direct to Consumer) projections were used for Nike Store and Nike Factory Store numbers. Rapid Response information was gathered from the Global Rapid Response projections for each geography. These numbers can easily be updated in the model to be used for scenario planning as well.

While growth rates were used to understand demand projections by being multiplied by shipments, improvement rates were multiplied by the inventory numbers. Inventory improvements were also added to the model to be able to understand the effect of implementing a project at a specific year. For example, without the improvement rate added, the model shows current state and target state projections. However, if a specific project focusing on improving internal orders was planning to be implemented in 2014, the user could implement the efficiency increase in 2014, which will effect 2014 and every year beyond. This allows timelines for improvement projects to also be modeled within the inventory model.

5 Global Model

The Global Model is a roll up of all geographies. This section is a more in depth look at the various differences within each geography model. The first models developed were China, Brazil, and North America to begin to understand the effects of being close to the source base, far from the source base, and have incredible supply chain complexity, respectively.

5.1 China Model Development

The first step in the China model development was to map the various supply chains China uses today. Although there is a growing Rapid Response business, China is predominantly considered a Seasonal / MTO geography as it makes up 99% of its total product. The complex flow of product on a MTO order is shown in Figure 12. This product flow represents the locations of inventory based on whether inventory is directly shipped, cancelled by the customer, returned, and sent to other partners or NFS.

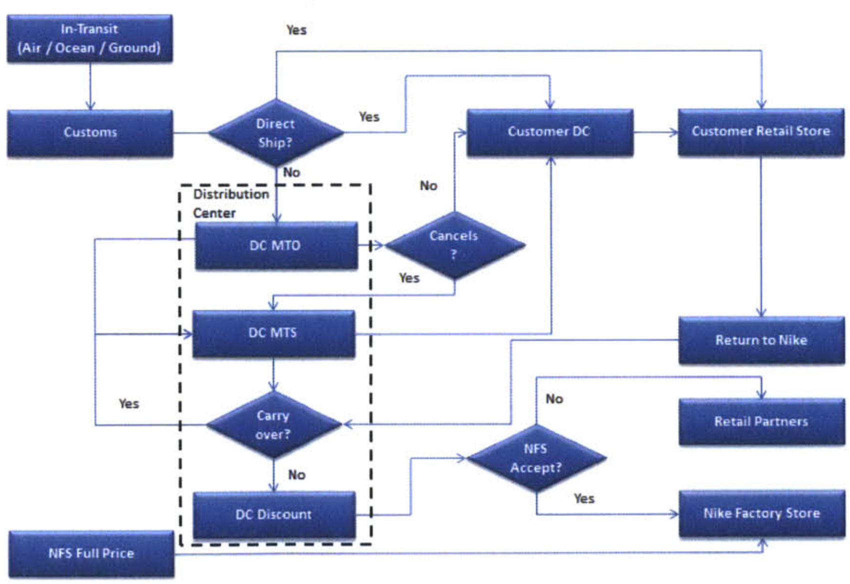

Figure 12. Seasonal / MTO Inventory Flow.

In addition to Seasonal / MTO inventory, China recently introduced the Rapid Response supply chain model. Given that Rapid Response can be MTO or MTS, the flow is fairly similar to the Seasonal / MTO inventory movement.

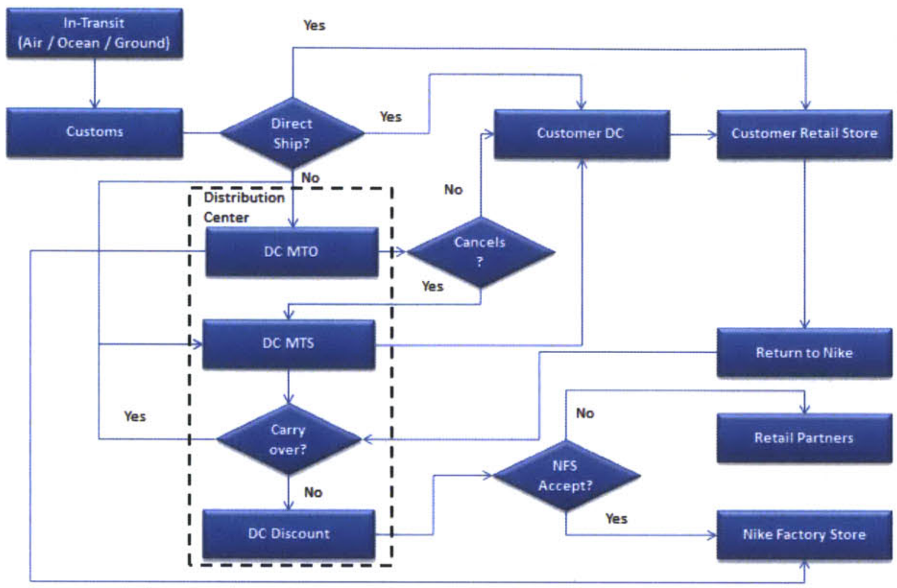

Figure 13. Rapid Response Inventory Flow.

Finally, the DTC process flow map is shown in Figure 14. DTC makes up all product that Nike sells through its own channels and does not go through wholesalers unless product is closed out or carried over to the next season.

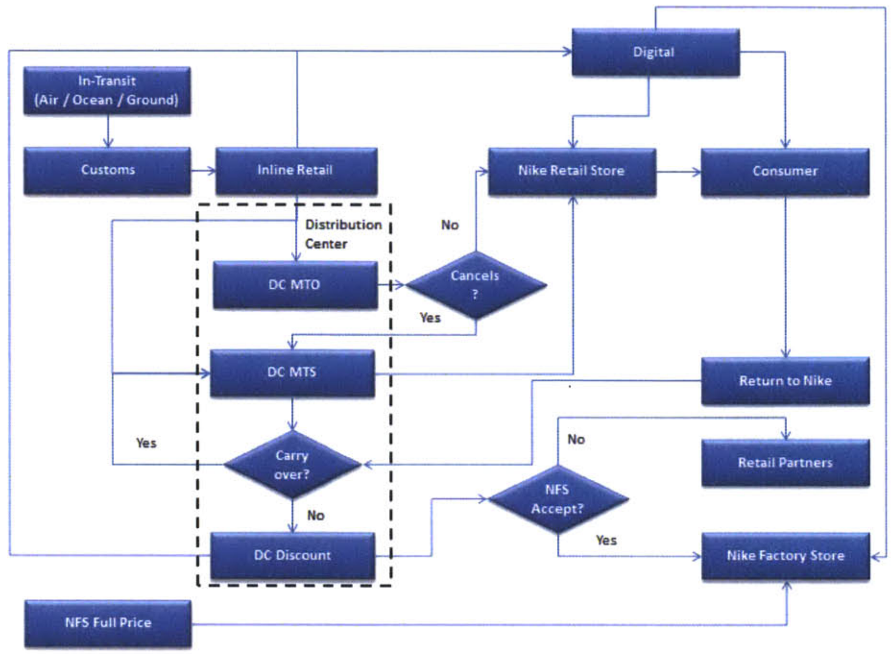

Figure 14. Direct to Consumer Inventory Flow.

China was an interesting geography to begin the analysis with since it had all of the inventory segments; however, since the more complex supply chain models were new and such a small segment, little information was tracked on a regular basis. It required long conversations with inventory managers to understand what information they would be able to obtain and how. Inventory information came from several sources in China, but the results showed how important tracking at a more granular level will be for China in the future. Having a large discount issue could potentially be solved by keeping a closer eye on MTS product or more specifically, product on contracts that is held far beyond their contract time. Table 4 lists China's value creation opportunities that came from several conversations and brainstorming sessions with inventory managers after showing them the results of the model.

Table 4. China Value Creation Opportunities.

Inventory Type(s)	Value Creation Opportunities
Early MTO, In-Transit Hold	▪ Planning process improvements will drive reduction in early MTO, DRS hold and consolidator hold days
NFS FP	▪ NFS FP postponement – continue to work cross-functionally to buy more accurately
Internal Orders	▪ Category contract release: enforce current policy of 45 days
NFS Discount	▪ Create policy for NFS discount contracts ▪ Expedite liquidation channel

5.2 Emerging Markets Model Development

The next model that was developed was the Brazil model for Emerging Markets. Although the market is largely MTO / Seasonal product, it was also difficult to obtain information at the granularity we needed. Brazil inventory is tracked differently from the rest of the geographies due to how transactions are handled. There are efforts to fix this inconsistency, but it was interesting to take out the in transit portion of Brazil. Figure 15 shows how the inventory flows through Brazil currently.

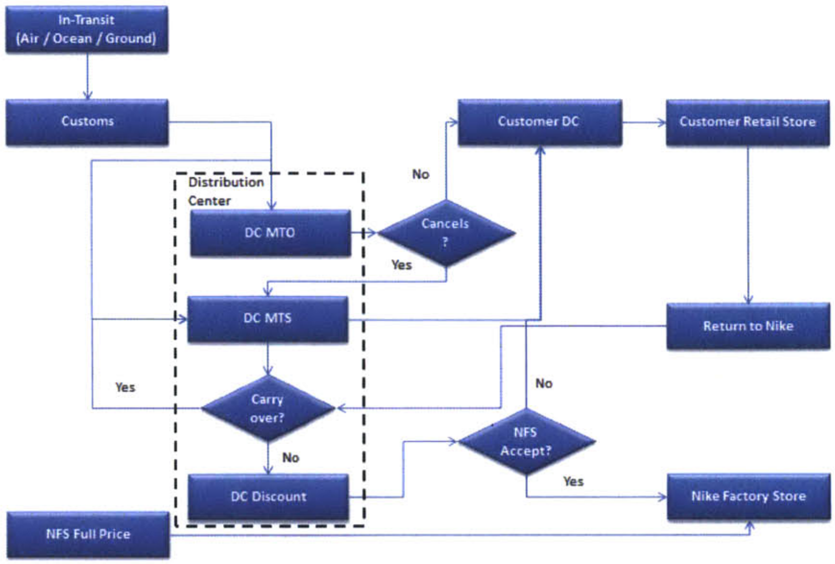

Figure 15. Brazil Inventory Flow.

Value creation opportunities for Brazil, which are similar to the rest of emerging markets is shown in Table 5.

Table 5. Brazil Value Creation Opportunities.

Inventory Type(s)	Value Creation Opportunities
Early MTO, In-Transit Hold	▪ Planning process improvements specific to merchandizing flow, sales order flow, purchase flow, and delivery flow will drive reduction in early MTO
Non-RR MTS	▪ Drive EPR and prop shipment, work with sales, S&OP, and finance for MTS order consumption
NFS Discount	▪ Manage NFS discount contract more closely ▪ Create policy for NFS discount contract
Discount – other	▪ Expedite liquidation channel ▪ Obtain support from sales to create stable liquidation channel

5.3 North America Model Development

The North America supply chain is the most sophisticated supply chain model at Nike, having all of the inventory segments modeled. The Rapid Response supply chain model began in North America and is by far the most closely tracked. North America sends daily inventory reports at the granularity of this model and maintains history records for this information. North America's largest opportunity lies within it's Rapid Response MTS product lines. Value creation opportunities for North America are listed in Table 6.

Table 6. North America Value Creation Opportunities.

Inventory Type(s)	Value Creation Opportunities
Early MTO, In-Transit Hold	▪ Planning process improvements will drive reduction in early MTO, DRS hold and consolidator hold days
DTC	▪ Staging inventory (60%-30%-10%) rather than front-loading at start of season (90%-10%) ▪ Gross to Net Initiative
NFS FP	▪ Staging inventory (60%-30%-10%) rather than front-loading at start of season (90%-10%)
Internal Orders	▪ Quarterly to Monthly order frequency ▪ Utilization Requirement (at least 75%)

5.4 Europe Model Development

The Europe Model was developed similarly to the North America Model; however, information was also difficult to come across initially do to the lack of regular inventory flow reports and history. Europe's largest opportunity should focus on Rapid Response MTS, which is discussed more thoroughly in the Deep Dives section of this thesis.

5.5 Japan Model Development

The final model created was the Japan model. Once again, although Japan had as many inventory segments as China, the lack of information proved to be detrimental in completing it to the correct granularity. Instead, DTC Nike stores was left in the Non-RR MTO inventory segment, internal orders were left within Non-RR MTS, and NFS Discount was considered as part of Discount- Other. This decision was made in part because the Japan market is actually the same size of Brazil with much smaller growth expected. However, discount inventory continues to be an issue and should be watched more tightly.

5.6 Global Model Roll Up

As all of the models were completed and validated by the respected inventory management team, the power of the model began to develop. Glaring issues were noticed and discussions regarding how to fix them or learn from other geographies took place. Furthermore, it was fascinating to understand how the growth of emerging markets would affect the future of Nike's inventory, especially with the World Cup and Olympics taking place in Brazil in the near future. Even more interesting was the comparison for each geography by product engine. Certain geographies may perform better in footwear, but carry more inventory in apparel. This is true for Europe RR MTO Apparel, which is better than North America RR MTO Apparel; however, Europe RR MTO Footwear is not nearly as lean as North America RR MTO Footwear.

6 Deep Dives

There were several deep dives and scenarios run for the Nike Global Inventory Model. First, it became apparent that the time inventory tended to stay in the consolidator if it was going to North America was much longer than if it was traveling to Europe. Being the same consolidator, one would expect similar processing times. It was discovered that more specifically, Apparel in North America remained far longer on average in the consolidator than other product engines. This is due to logic in manufacturing planning for direct ship items. There is a prioritization that was put in place several years ago that ensures direct ship apparel is manufactured before any non-direct ship apparel. This is even the case if the delivery date is two months after a non-direct ship item. For example, if a customer needed a direct ship item for March, but there was a non-direct ship item of apparel needed for January, the direct ship item for March would have priority over the January item. This would cause the March item to hit the consolidator before it needed to be shipped. Instead of shipping this item, incurring duty and holding the item at the DC, Nike appropriately chooses to hold the item at the consolidator. However, careful planning by updating the logic in the system could ameliorate this problem immediately. This is especially important as North America is the largest inventory driver in terms of geography and apparel drives inventory the most of any product engine.

Another deep dive involved North America Rapid Response product. It was determined that 2% of Rapid Response styles caused 50% of the stockouts, while 10% of Rapid Response styles cause 82% of stockouts. Athletic training, women's training operated too leanly, while Nike sportswear and basketball carried far too much inventory based on their volumes.

To continue with the Rapid Response MTS deep dives, it is recommended that a volume – variability analysis as shown in Figure 16 is performed for North America and Europe. To do this, one must isolate the high stock-out and high-DSI style colors. This requires an deeper understanding to a higher granularity than the current granularity within the Global Inventory Model using modeling tools to operationalize demand planning and inventory policies.

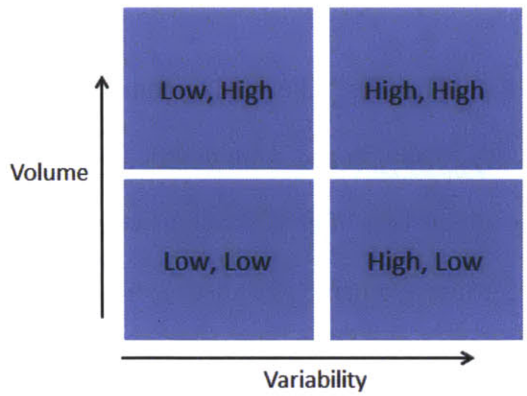

Figure 16. Volume - Variability Analysis.

7 Conclusions

The Predictive Global Inventory Model provides Nike with several benefits such as: understanding inventory positions from now until FY2020 with and without efficiency increases, providing the opportunity for knowledge sharing with a "best of breed" system, allowing sensitivity analyses, determining whether inventory targets are attainable, and discovering how new business models affect inventory.

One example of the above capabilities includes the conclusion that the large driver of overall inventory for Nike Brand is North America Non-RR MTO for apparel. However, if one studies this specific DSI and compares it to other geographies, this specific inventory segment is very lean. Therefore, knowledge sharing from another geography would not be helpful. Instead, North America must focus on other areas such as Rapid Response MTS inventory. It is uncovering the large drivers of inventory that are inefficient in comparison to other geographies that provide the largest area of improvement.

7.1 Key Findings

The Global Inventory Model is a useful as it allows Nike to understand and review major differences between each geography at a much lower granularity in a standardized way. Interesting insights can be drawn from the largest drivers shown in Table 2 and the scorecard reports similar to Figure 10. Furthermore, scenarios run to understand the sensitivities of changing efficiencies and business levers in the model also provide Nike information as to where to focus.

7.2 Next Steps

The Global Inventory Model as already been handed off to the Global Performance Management team. The team is expected to integrate the model findings into the target setting process by comparing and validating the numbers against last year's projection. A dedicated resource has already been determined and will be responsible for future updates.

One major risk of the model is to understand that the inputs beyond North America require geography validation by Inventory Managers. There is not currently a single standardized report to compare the geographies at this level. As the make-to-stock supply chain strategy grows throughout Nike, it becomes increasingly more imperative to watch the MTS order closely. This can be accomplished by using the North America inventory flow reports. The major recommendation for the project is to launch the inventory flow reports to the rest of the geographies beyond North America, allowing data for model enhancements will be readily available. All Emerging Markets territories or specific countries within North America and Europe could also be modeled if these reports were launched. Finally, further enhancements to the model may also include projecting inventory month by month or by quarter for the next several years.

8 References

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Appendix A – Nike Global Inventory Model User Manual

**Note company-specific data and information has been removed or blurred for confidentiality purposes*

I. USER EXCEL FILES AND TABS EXPLAINED

The Global Inventory Model is made up of ten (10) excel sheets of 55 tabs each. The 55 tabs are explained in Appendix B. The following files make up the complete global inventory model:

1. **Nike Brand Roll Up v0.xlsx**
2. EM Inventory Model Roll Up v0.xlsx
    - I. EM Asia Inventory Model v0.xlsx
    - II. EM Americas Inventory Model v0.xlsx
        - a. Brasil Inventory Model Rollup v1.xlsx
        - b. EM Americas Minus Brasil Inventory Model v0.xlsx
3. Europe Inventory Model Rollup v3.xlsx
4. China Inventory Model Rollup v1.xlsx
5. Japan Inventory Model Rollup v1.xlsx
6. NA Inventory Model Rollup v1.xlsx

Main Page

The first sheet for every spreadsheet is the main page for the model. An example of Brazil's main page is shown in Figure A.1. Its purpose is to aid in quick navigation throughout the entire spreadsheet. The orange buttons can be pressed to open up the specific spreadsheet labeled on the button. The buttons are separated by *inputs*, *parameters*, *Days of Forward Coverage (DFC) calculation*, *output*, and *optimal inventory plan*.

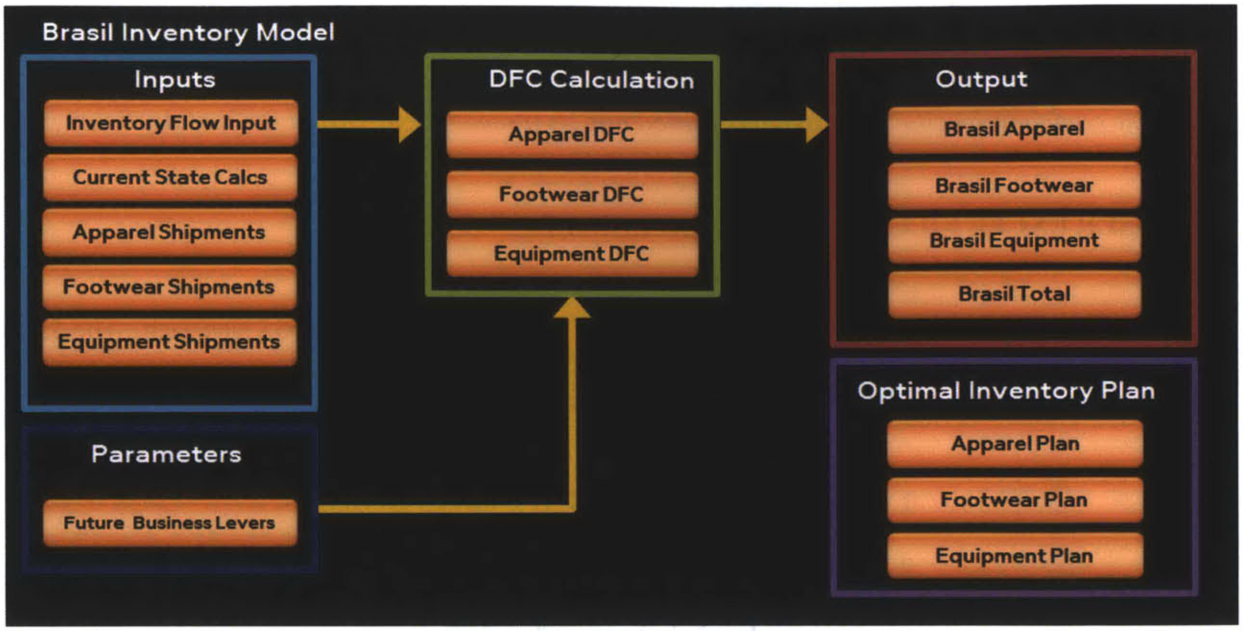

Figure A.1. Main Page Example.

Input - The main inputs to the model are inventory units and shipments. To calculate the inventory units and shipments, inventory flow input and SRI shipments information are necessary.

Parameters - The parameters in this model are numbers needed to project inventory positions from 2014 to 2020. More specifically, the business growth variables are applied to shipments, while the improvement assumptions are applied to inventory units. There is also the ability to model the approximate Air, Vessel, and Truck transit split.

DFC calculation - These pages show the structural limit, actual, and optimal DFC calculation.

Output - The buttons in the output section take the user to the graphical representation of the model outputs. The current state and optimal states are depicted from 2012 to 2020.

Optimal Inventory Plan - The optimal inventory plan explains the improvements in DFC for each inventory segment and the actions behind them. These numbers are based upon discussions with inventory managers in each geography or territory (e.g. Brasil).

Model Description

The second tab in the model is labeled "Model Description" and is a brief overview of the model methodology.

More specifically, a there is a description of the DFC concept as well as an explanation of how SRI shipments are calculated for each inventory segment.

DFC concept

DFC stands for "Days of Forward Coverage." It is similar to the Days of Sales in Inventory (DSI) concept, but differs in that it does not use Nike's true definition of DSI and is forward-looking. Further explanation as to how it is calculated is located in the DFC Calculation Section.

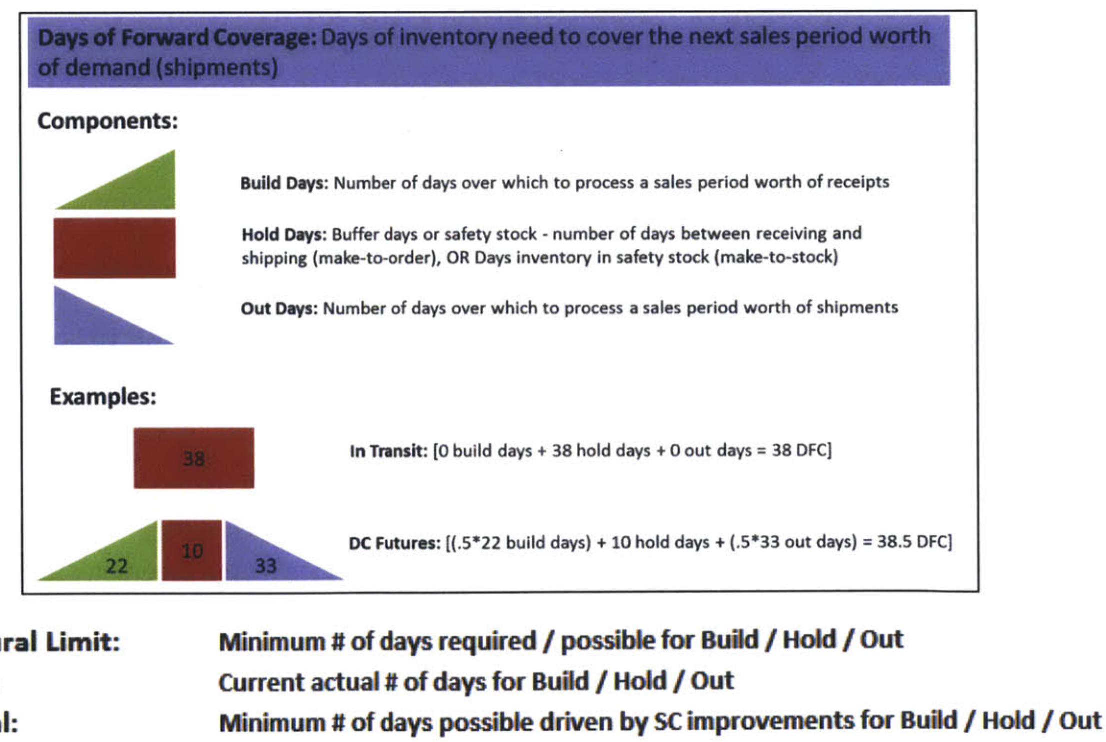

Figure A.2. DFC Concept Explanation.

The shipments are calculated direction from SRI as follows:

Table A.1. Shipment Calculations.

LifeCyclePhase	Location	Inventory Type	Calculation
Pre-Sell	In-Transit	Consolidator	Total Shipments * (% Vessel + % Air)
Pre-Sell	In-Transit	Air	Total Shipments * % Air
Pre-Sell	In-Transit	Vessel	Total Shipments * % Vessel
Pre-Sell	In-Transit	Truck	Total Shipments * % Truck
Pre-Sell	In-Transit	Customs	Total Shipments * (% Vessel + % Air)
Full Price	In-Transit	DRS	DRS Shipments
Full Price	DC	RR MTO	(DC RR MTO / Total DC Shipments) * (Total DC Shipments - Shipments to Retail)
Full Price	DC	Non-RR MTO	(DC Non-RR MTO / Total DC Shipments) * (Total DC Shipments - Shipments to Retail)
Full Price	DC	RR MTS	(DC RR MTS / Total DC Shipments) * (Total DC Shipments - Shipments to Retail)
Full Price	DC	Non-RR MTS	((DC Non-RR MTS / Total DC Shipments) * (Total DC Shipments - Shipments to Retail)) * (1 - % Internal Orders)
Full Price	DC	DTC Nike Stores	Full Price Shipments to Nike Stores
Full Price	DC	NFS Full Price	Full Price Shipments to NFS
Full Price	DC	Internal Orders	((DC Non-RR MTS / Total DC Shipments) * (Total DC Shipments - Shipments to Retail)) * (% Internal Orders)
Discount	DC	NFS Discount	Off Price Shipments to NFS
Discount	DC	Discount - Other	(Total Off Price Shipments - Off Price Shipments to NFS)

8.1.1.1 *Inputs*

Inventory Flow Inputs

The inventory flow inputs page is a major input in calculating the DFC for each inventory segment. All geographies except Europe and North America, who calculated DFC outside the model, have this page.

The transit time information is provided by the APL Dashboard for all geographies. The approximate percent shipped via air, vessel, or truck is provided by the geography themselves (Brasil) or using event manager information in Sharepoint (See Figure A.6).

	Input	Apparel	Footwear	Equipment	Reference
In Transit	Consolidator Processing Time [days]				APL Dashboard
	Vessel Transit Time [days]				APL Dashboard
	Air Freight Transit Time [days]				APL Dashboard
	Truck Transit Time [days]				Approx.
	Customs Processing Time [days]				APL Dashboard
	Direct Ship Transit Time				
	% AF				FY12 - Stats - Imported - Local
	% VL				FY12 - Stats - Imported - Local
	% TR				FY12 - Stats - Imported - Local
In DC	DTC as % of Futures				Brasil Input
	% Wholesale				Brasil Input
	% RR MTO				Brasil Input
	% Non-RR MTO in DC				Brasil Input
	% RR MTS in DC				Brasil Input
	% Non-RR MTS in DC				Brasil Input
	DTC Nike Stores				% DTC x Non-RR MTO
	NFS Full Price				Brasil Input
	% Internal Orders				Brasil Input
	% NFS Discount				Brasil Input
	% Discount - Other				Brasil Input

Figure A.3. Inventory Flow Inputs Tab.

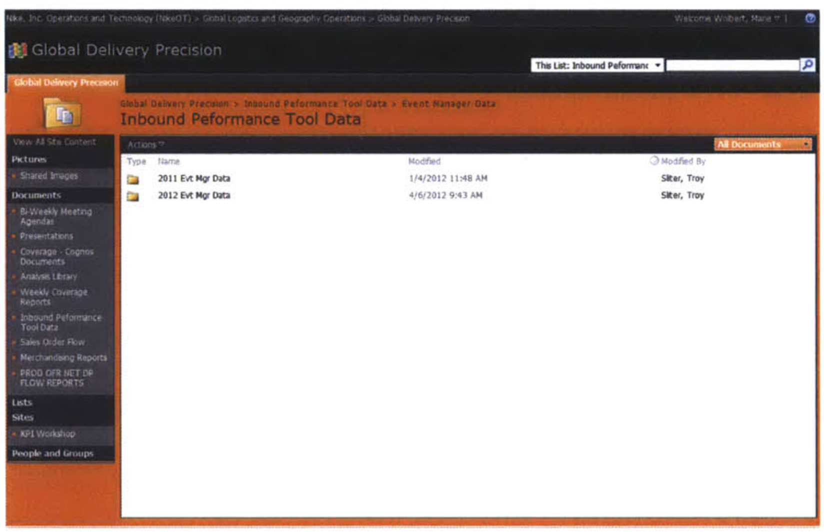

Figure A.4. Event Manager Data Files in Sharepoint.

Current State Calculations

The current state calculations are interim calculations taken from the inventory flow inputs page that are directly fed into the shipments tabs. The layout is shown in Figure A.5.

Apparel

Description	%	Reference
Consolidator / Customs		In-Transit Air + In-Transit Vessel
% In-Transit Air		Brasil Inputs
% In-Transit Vessel		Brasil Inputs
% In-Transit Truck		Brasil Inputs
Internal Orders as % of MTS		Brasil Inputs

Footwear

Description	%	Reference
Consolidator / Customs		In-Transit Air + In-Transit Vessel
% In-Transit Air		Brasil Inputs
% In-Transit Vessel		Brasil Inputs
% In-Transit Truck		Brasil Inputs
Internal Orders as % of MTS		Brasil Inputs

Equipment

Description	%	Reference
Consolidator / Customs		In-Transit Air + In-Transit Vessel
% In-Transit Air		Brasil Inputs
% In-Transit Vessel		Brasil Inputs
% In-Transit Truck		Brasil Inputs
Internal Orders as % of MTS		Brasil Inputs

Figure A.5. Current State Input.

Apparel, Footwear, and Equipment Shipments

The Apparel, Footwear, and Equipment Shipments buttons take the user to the shipments pages for each product engine. This shipments tab feeds from the current state input and SRI tabs and are used to calculate DSI in the model. A snapshot of an example shipments page is shown in Figure A.6.

				[redacted]
				Jun-11
			In-Transit Air	
			In-Transit Vessel	
			In-Transit Truck	
			DC	
				[redacted]
			Shipments (Actuals/Proj)	
S/NS	LifeCyclePhase	Location	Inventory type	June
NS	Pre-Sell	In-Transit	Consolidator	
NS	Pre-Sell	In-Transit	Air	
NS	Pre-Sell	In-Transit	Vessel	
NS	Pre-Sell	In-Transit	Truck	
NS	Pre-Sell	In-Transit	Customs	
S	Full Price	In-Transit	DRS	
S	Full Price	DC	RR MTO	
S	Full Price	DC	Non-RR MTO	
S	Full Price	DC	RR MTS	
S	Full Price	DC	Non-RR MTS	
S	Full Price	DC	DTC Nike Stores	
S	Full Price	DC	NFS Full Price	
S	Full Price	DC	Internal Orders	
S	Discount	DC	NFS Discount	
S	Discount	DC	Discount - Other	

Figure A.6. Shipments Tab Example.

Parameters

The parameters section on the main page sends the user to the future business levers tab shown in Figure A.7. The future business levers tab includes growth assumptions, improvement assumptions, and air / vessel / truck splits from 2013 to 2020.

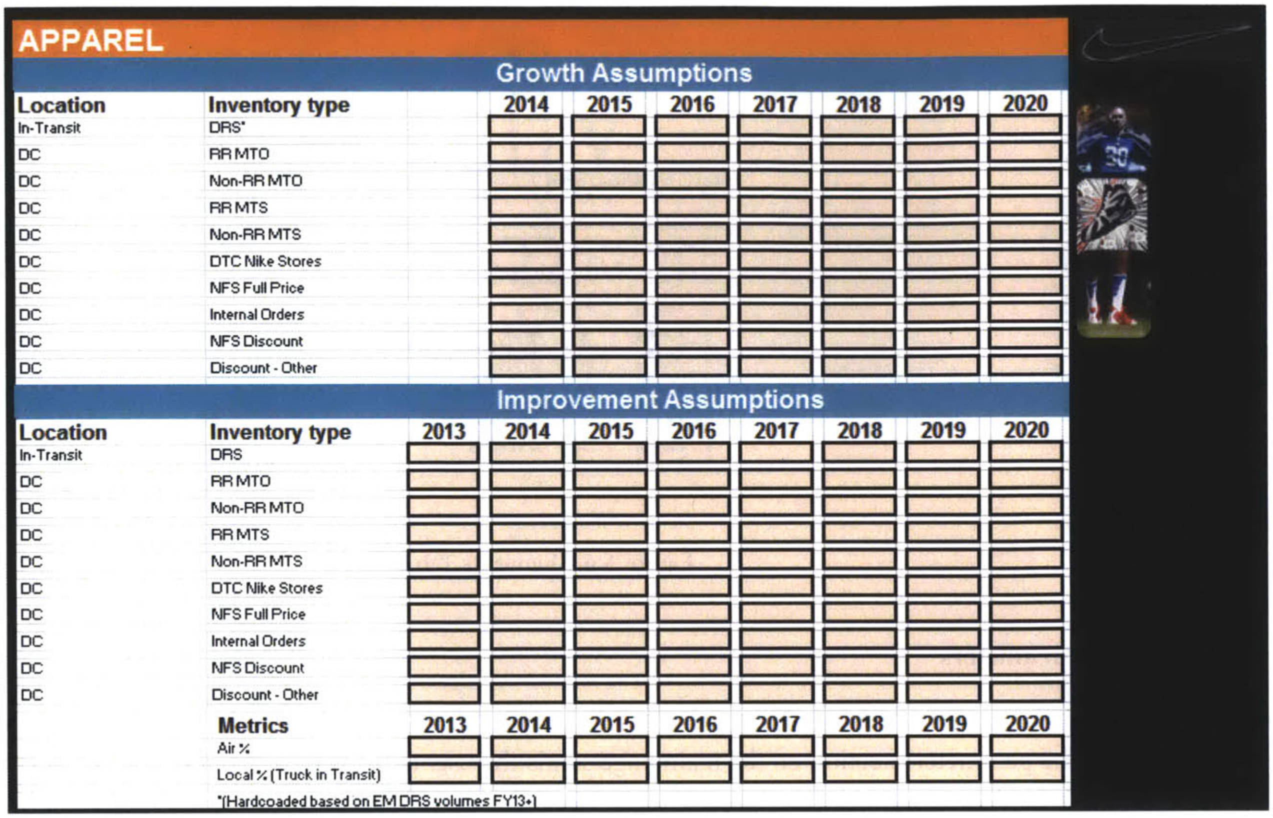

Figure A.7. Future Business Levers Example.

The growth assumptions sections are input from several sources, including the global Corporate Strategy Review (CSR) decks, global Rapid Response targets, Direct Ship (DRS) projections, and DTC projections. These percentages are applied to the previous year's total shipments to replicate the year over year growth in demand.

The improvement assumptions can be used for scenario planning or for assumptions based on improvement project implementation. These percentages are applied to future inventory levels and can be positive or negative. This models the efficiency increases or decreases for each inventory type. For example, if the Non-RR MTO flow for North America was planned to change in 2014, the user could apply the approximate improvement in the 2014 column for Non-RR MTO. This effect of this improvement could be seen in the 2014 to 2020 output graphs.

Furthermore, scenarios can be run to determine the effect on DSI for various modes of transit. The user can input assumed percentages sent via air freight or truck (the rest of the percentage is considered vessel) and quantify this effect by comparing the output graphs. Truck transit is assumed to not hit the consolidator nor customs, therefore not only decreasing transit time, but also avoiding consolidator and customs processing times.

DFC Calculation

The DFC Calculation tabs hold the structural limit, actual, and optimal DFC numbers and shown in Figure A.8. The structural limit is defined as the minimum days an inventory segment would in the most ideal situation, assuming a complete flow through supply chain. The actual DFC are the numbers calculated from the inventory flow inputs and shipments. The optimal DFC is the DFC agreed upon by geographies taking into consideration improvement projects set in place.

							Structural Limit			Actual DFC			Optimal DFC					
S/NS	LifeCyclePhase	Location	Inventory type	SL Wt %	Actual Wt%	Opt Wt %				Build Days	Hold Days	Out Days	Build Days	Hold Days	Out Days	DFC_SL	DFC_Act	DFC_Opt
NS	Pre-Sell	In-Transit	Consolidator	100%	100%	100%												
NS	Pre-Sell	In-Transit	Air	100%	100%	100%												
NS	Pre-Sell	In-Transit	Vessel	100%	100%	100%												
NS	Pre-Sell	In-Transit	Truck	100%	100%	100%												
NS	Pre-Sell	In-Transit	Customs	100%	100%	100%												
S	Full Price	In-Transit	DRS	100%	100%	100%												
S	Full Price	DC	RR MTO	100%	100%	100%												
S	Full Price	DC	Non-RR MTO	100%	100%	100%												
S	Full Price	DC	RR MTS	100%	100%	100%												
S	Full Price	DC	Non-RR MTS	100%	100%	100%												
S	Full Price	DC	DTC Nike Stores	100%	100%	100%												
S	Full Price	DC	NFS Full Price	100%	100%	100%												
S	Full Price	DC	Internal Orders	100%	100%	100%												
S	Discount	DC	NFS Discount	100%	100%	100%												
S	Discount	DC	Discount - Other	100%	100%	100%												

Figure A.8. DFC Calculation Tab.

Outputs

The outputs tab take the user to the graphical representation of DSI from 2012 to 2014 for both the current state and optimal states. These tabs are a summary of all the input tabs and an example output tab is shown in Figure A.9.

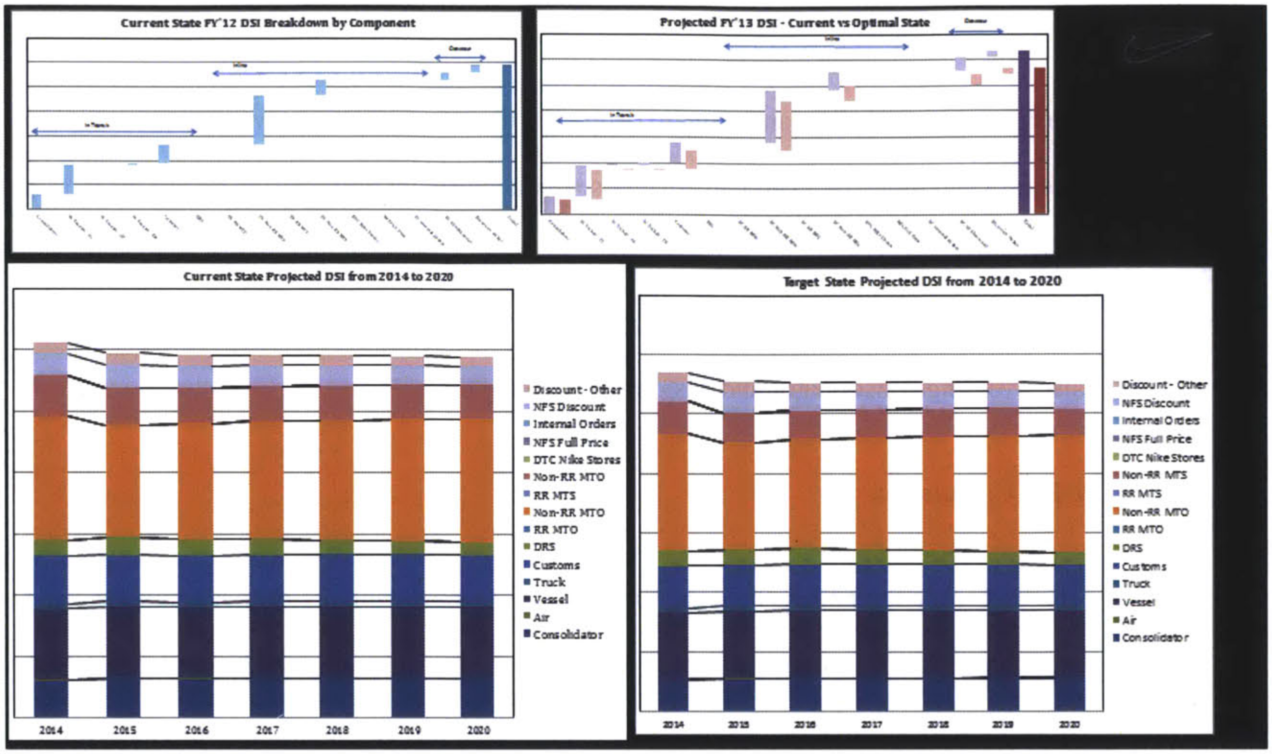

Figure A.9. Inventory Model Output.

Optimal Inventory Plan

The optimal inventory plan tabs list the actual DFC and optimal DFC for each product engine. This tab also lists the expected implementation date, a description of the action, and any additional notes. An example of this tab is shown in Figure A.10.

Equipment Optimal Inventory Plan

#	Component	Proposed Action	Current DFC	Target DFC	% DFC Improvement	Expected Timeline	Owner
1	Consolidator						
2	Air						
3	Vessel						
4	Truck						
5	Customs						
6	DRS						
7	AA Futures						
8	Non-AA Futures	Flow (Merchandizing flow, sales order flow, purchase flow, and delivery flow)					Merch/Sales
9	AA At-Once						
10	Non-AA At-Once	Drive EPR & Prop shipment - AO order consumption, work w/ sales, S&OP,					Demand Pull limiting Inventory investment
11	DTC Nike Stores						
12	DTC - NFS (Builds)						
13	Internal Contracts						
14	NFS	NFS closeout contract management, create policy for NFS closeout contract					Current Trade Restrictions driving lifecycle extensions and lower closeout quantities. As we discontinue this we will be challenged to hold closeout at this level.
15	Closeout / Value	Expedite the liquidation channel, obtain support from sales to create stable liquidation channel					NFS expansion will help drive additional capacity for liquidation of EQ and lessen reliance on outside accounts. 6+ NFS stores planned in next 12 months will have impact.

Figure A.10. Optimal Inventory Plan Snapshot.

II. AUXILIARY TABS EXPLAINED

There are several additional tabs that the user does not need to interface with; however, they are very important for interim calculations and model updates. This section explains the rest of the tabs necessary to build the global inventory model

SRI Tabs

There are three SRI tabs per spreadsheet: AP SRI, FW SRI, and EQ SRI. These tabs are exported directly from SRI and fed into the shipments tabs. The following steps are taken to create this tab:

Step 1: Obtain Access to the SRI Portal under "Requesting Access to Global SRI" at the following page:

http://sharepoint/got/vc2015/ptc/sri/Training/_portal/about.html

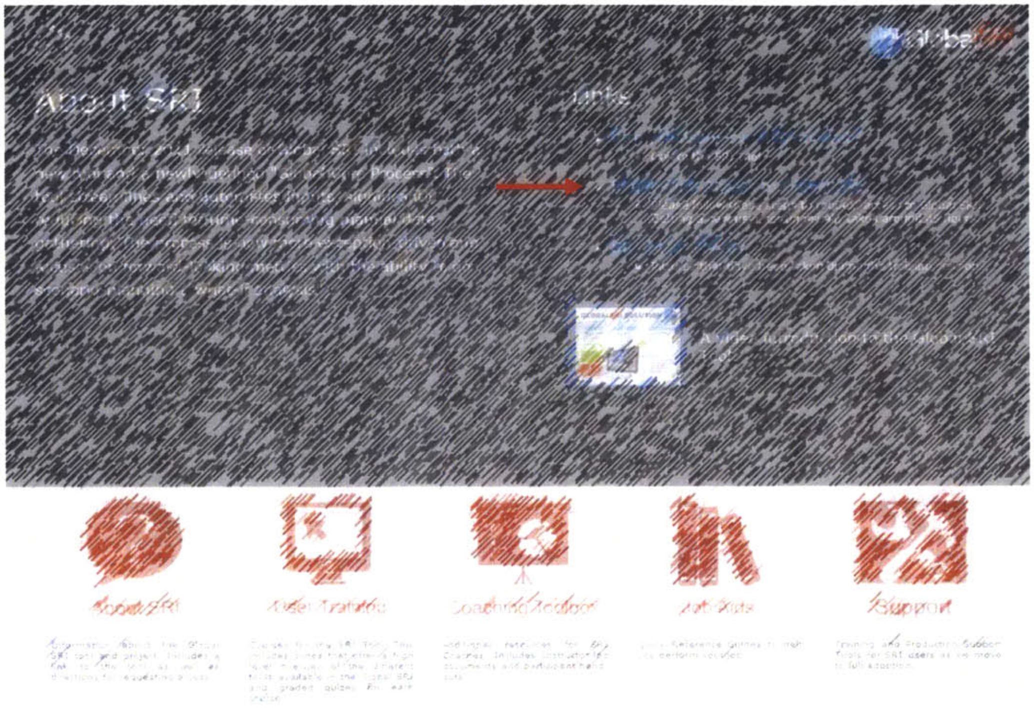

Figure A.11. SRI Homepage – Requesting Access.

Step 2: Read the Global SRI overview under "About SRI" and browse "User Training" to get a better sense of the tool and its use.

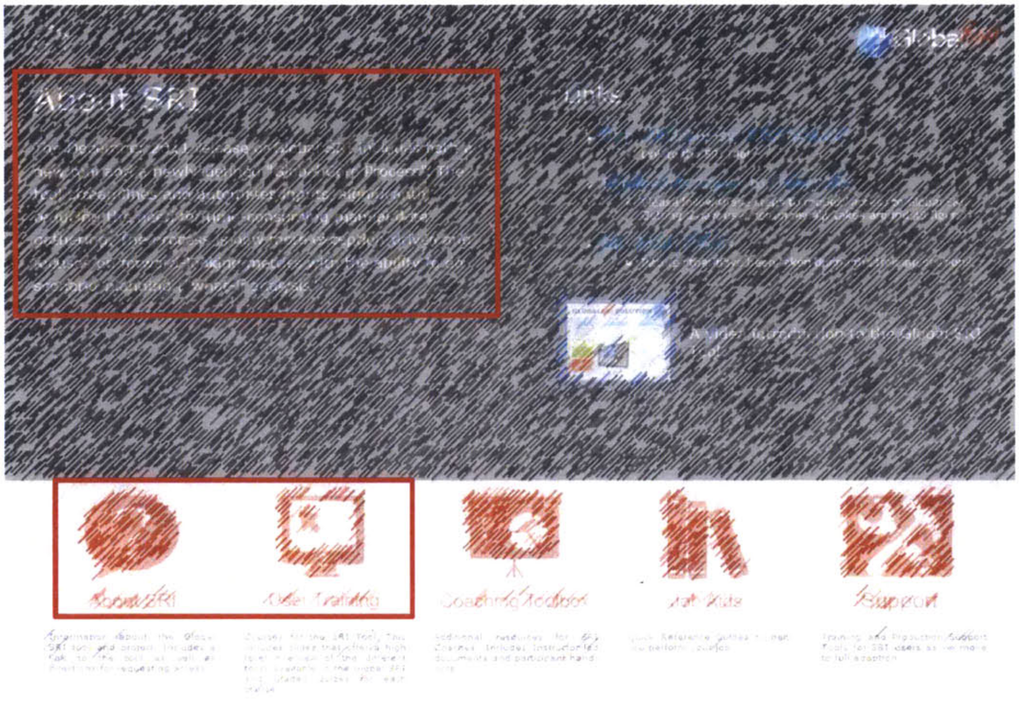

Figure A.12. SRI Homepage – About SRI / User Training.

Step 3: After obtaining access to the SRI tool, go to:

http://hillsbor-svr-m6/tm1web/

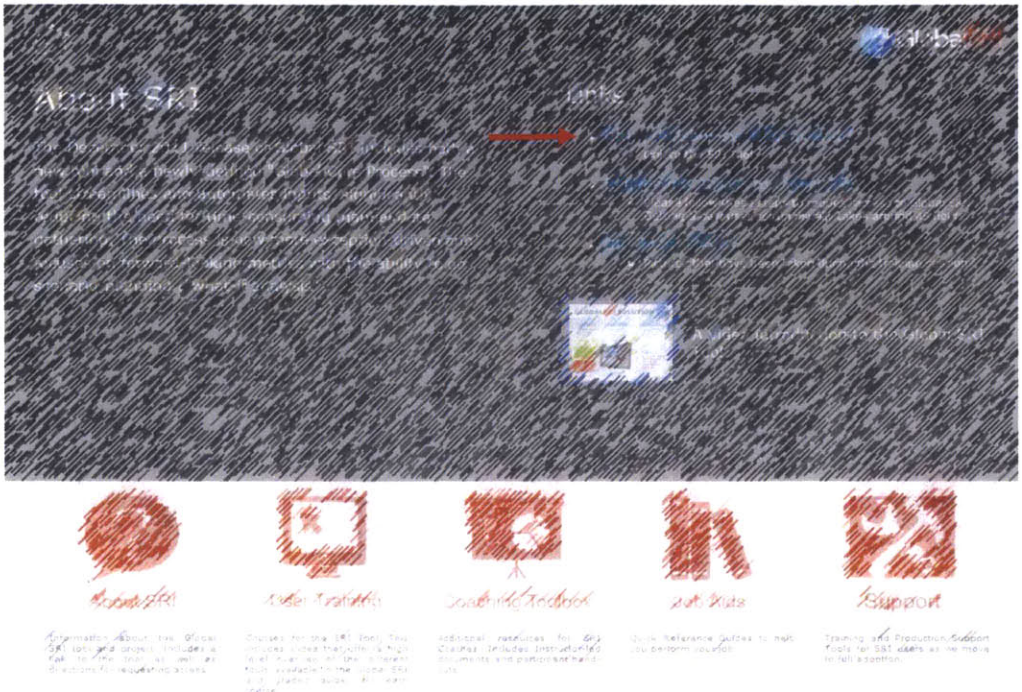

Figure A.13. SRI Homepage – SRI Tool.

This will lead you to the following page:

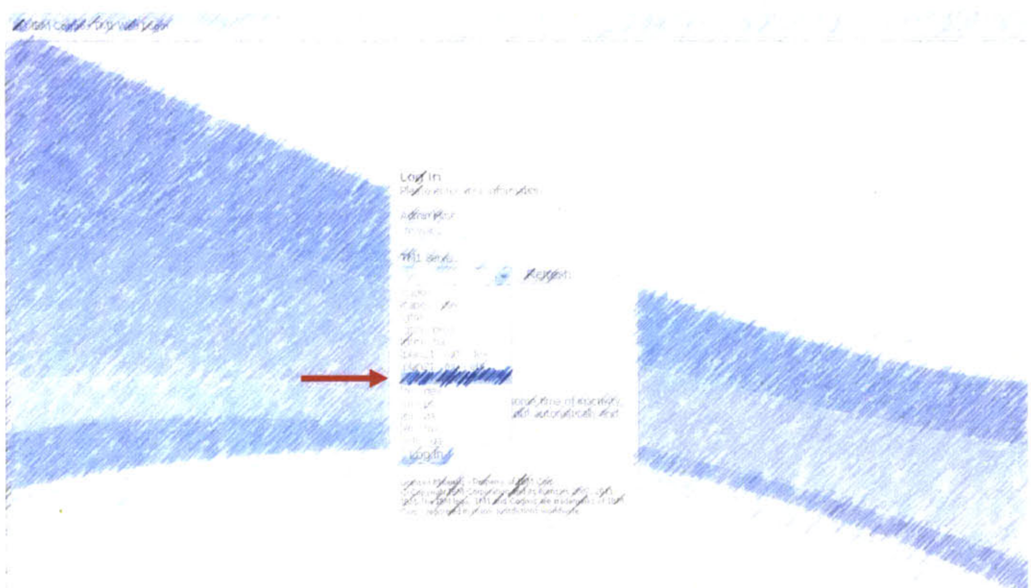

Figure A.14. Cognos Log In for SRI Tool.

Choose "sri" and click "Log In" to be sent directly to the SRI data.

Step 4: The SRI tool interface is shown in Figure A.15:

Figure A.15. SRI Tool.

Under the Planning section, click Monthly Inventory Movements (see the red arrow in Figure A.15) to obtain the shipment data used for every sheet in the global inventory model.

Step 5: For this example, we will be searching for North America Apparel SRI information. The user can also search for any geography or territory and any product engine (Footwear and Equipment) by selecting the name in the respective drop downs.

To select North America, select the downward arrow ▾ under "Plng Ctry," highlight "NORTH AMERICA," and click OK.

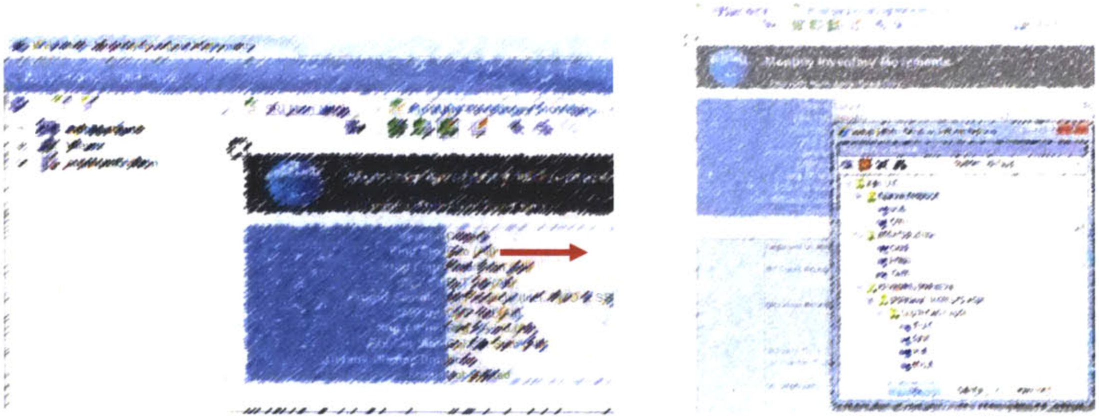

Figure A.16. SRI Geography Selection.

To select Apparel, select the downward arrow under "Prod Engn," highlight "Apparel," and click OK.

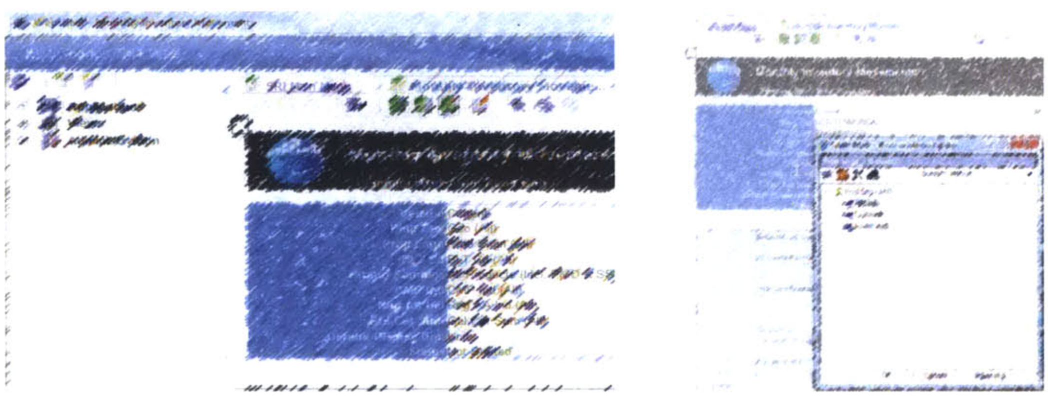

Figure A.17. SRI Product Engine Selection.

Finally, the inventory model excludes all promo and samples. Therefore, the user must select the downward arrow under "Promo Samples," highlight "All Products (Excl. PMO & SS)," and click OK.

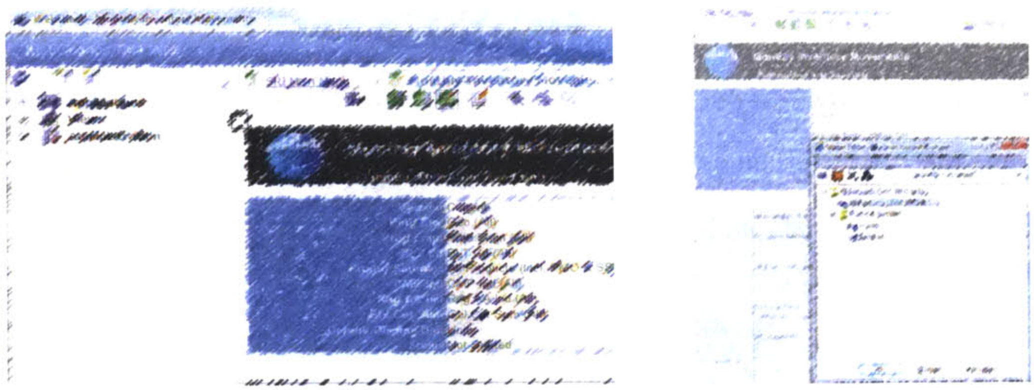

Figure A.18. SRI Samples Exclusion.

The user is now ready to export the SRI information for North America Apparel. To do this, the user must click the downward arrow located in the top left corner, select "Snapshot to Excel," click "OK," and then "Save" (see Figure A.19). The user can chose the folder in which he would like it saved and open it to insert into the global inventory model.

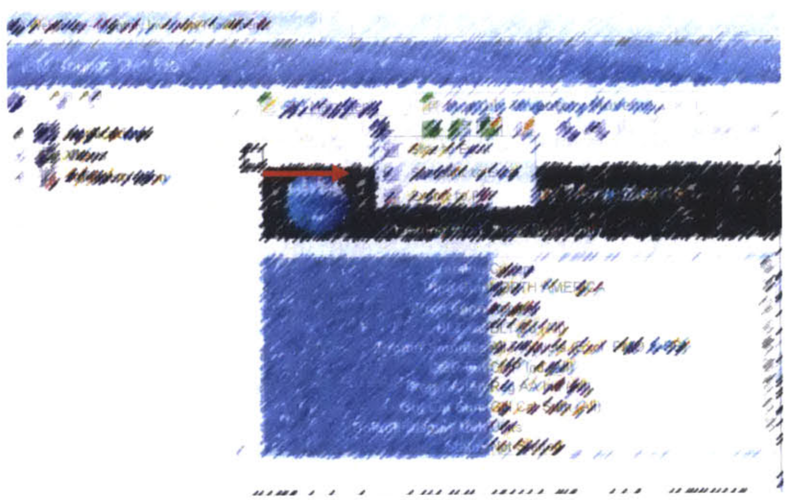

Figure A.19. SRI Samples Exclusion.

To insert the information in the model, the user needs to select all cells from B24 to AA85 for the original creation of the model (Note: to update the model, only the new months need to be imported). These cells can be directly pasted into the "AP Shipments" tab for each product engine and geography. For previous /historic years, the user must go back to the SRI tool interface Figure A.15 and select SRI by Plant report. These reports are similar to the Monthly Inventory Movements data files; however, there is a drop down capability to select specific years. Selection and export steps are the same as the Monthly Inventory Movements.

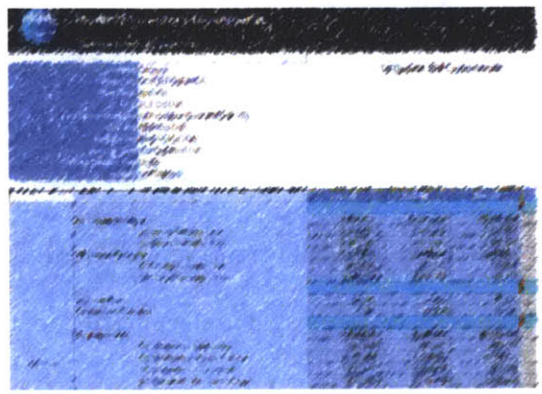

Figure A.20. Importing Shipment Information to Global Inventory Model.

III. HOW TO USE THE MODEL

The model can be used to answer several questions such as:

I. What are Nike's future inventory positions?

II. Where should we focus our efforts?

III. What is the payoff of the focused efforts?

IV. Are our targets attainable given our current business models?

V. How can we compare geographies?

VI. How do Nike's new business models effect future DSI?

What are Nike's future inventory positions?

As the model stands today, the user can determine Nike's future inventory models with the latest growth projections already input into the model. This information can be found by opening the

Nike Brand Roll Up v0.xlsx spreadsheet and clicking on the "Nike Brand Total" link in the Outputs section. Graphical representations of inventory positions are shown from 2012 to 2020. Nike Brand product engines can be viewed separately by clicking on the apparel, footwear, or equipment output buttons. Furthermore, these projections can also be viewed in a similar manner for all geographies by opening the excel file for the geography of interest.

Where should we focus our efforts?

A sensitivity analysis for all geographies has already been completed. After future updates, the user can recreate a sensitivity analysis by changing the DFC assumptions pages by product engine and geography and checking the total geography output on the change in addition to the Nike Brand roll up output. This will give the user an idea of where the opportunity lies: the inventory segment change with the largest geography or Nike DSI change is the largest inventory driver.

Another way to determine where to focus efforts is to compare across geographies; the user can deep dive into inventory segments with DFCs that are significantly large in one geography and potentially obtain best practices from a geography with a small DFC. Note that although this opportunity exists, the user should check to see how much the inventory segment drives the overall geographical inventory position using the sensitivity analysis. This will give the user a better sense of how much the DFC must decrease for the effort to take effect.

What is the payoff of the focused efforts?

Focusing effort to drive down the DFC of an inventory segment can be quantified using the optimal inventory plan in each spreadsheet. Once an opportunity is identified, the optimal DFC can be updated in the DFC assumptions tab. The effect of this change can be shown in the output of the specific product engine, the total geography, or even the overall Nike Brand roll up. Note that since this change is made to the "optimal" DFC, the optimal state output is the useful information.

Are our targets attainable given our current business models?

Another way this model can be used is to determine if the targets set for specific geographies are attainable. More specifically, the user can use the sensitivity analysis and assumed improvements to determine different DFC combinations each inventory type results in a geography meeting the target.

How can we compare geographies?

Geographies are already compared by inventory segment in the Nike Brand roll up excel file. This can be done for each geography in total or for each product engine specifically. This information can provide insights into who is operating efficiently in certain areas, providing a basis for conversation and best practice sharing.

How do Nike's new business models effect future DSI?

The long term effect of new supply chain business model creation is often uncertain as new at Nike. This model allows the user to decouple Rapid Response MTO and MTS product from non-Rapid Response product. This separation gives data to show that it is not the business model that drives inventory levels, but more specifically the order type. MTS orders tends to move through the DC much less efficiently than MTO orders; therefore, business models creating more MTS product will inherently drive inventory numbers up. However, the MTS efficiency will likely change, potentially increasing overall MTS product efficiency through the DC. This model as the ability to depict this scenario through growth in MTS shipments and changes in MTS DFC numbers.

IV. HOW TO UPDATE THE MODEL

This model currently uses FY12 historical and FY13 historical / forecasted SRI information. In order to update the model for FY13, the shipments section must be updated.

In future years, a full model refresh can be completed by determining new DFC values for each inventory type in addition to adding new fiscal year shipment information.

FY13 Shipments

In order to update the model for the rest of FY13, the user must replace the forecasted information from November to May with actualized and new forecasted information from SRI. This is completed by following the steps under the Shipment Tabs section. As a reminder, the user must log into SRI, choose the correct product engine and geography, and export the information to excel.

The user then can then copy the specific months that have been actualized and place them directly into the SRI tab of interest. The columns can be pasted directly over the data. Note: actualized / historical data can be determined by DTC information. Currently, SRI does not forecast Nike Store and NFS information; therefore, the user can be certain the information has been updated in SRI by these lines being completed. Newly forecasted information should also be updated to ensure the most accurate information.

Future Years Updates

DFC Update

The model can be refreshed at a yearly cadence by not only updating shipment information, but also DFC information.

As business changes at Nike and as efficiencies change, the user has a few options to update the model:

1. The actual DFC numbers can be refreshed entirely for all geographies (see below)
2. Improvement percentages can be applied for each year to model improvement project effects

Option one (1) can be done in multiple ways, depending on the availability of information for each geography. Currently, both North America and Europe have found ways to obtain the inventory segment DFC information outside of the model. Therefore, the updated DFC information should come directly from the two geographies. If there are limited resources within the inventory management teams in North American and Europe, the user can update the DFC information as long as he has access to the inventory flow reports (or something of the like). The DFC information can be calculated using FY13 (currently DFC information is based on FY12) as an example as follows:

1. Inventory Flow reports (see Figure A.21) will have inventory segmented in the appropriate buckets as listed in the model, and the information provided is given in inventory units (see Figure A.22). For the purposes of this model, the DFCs can be calculated in two ways.

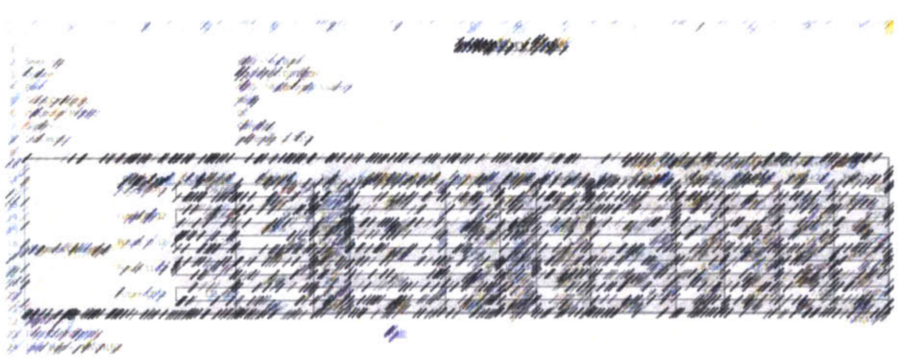

Figure A.21. First Page Example of Inventory Flow Reports.

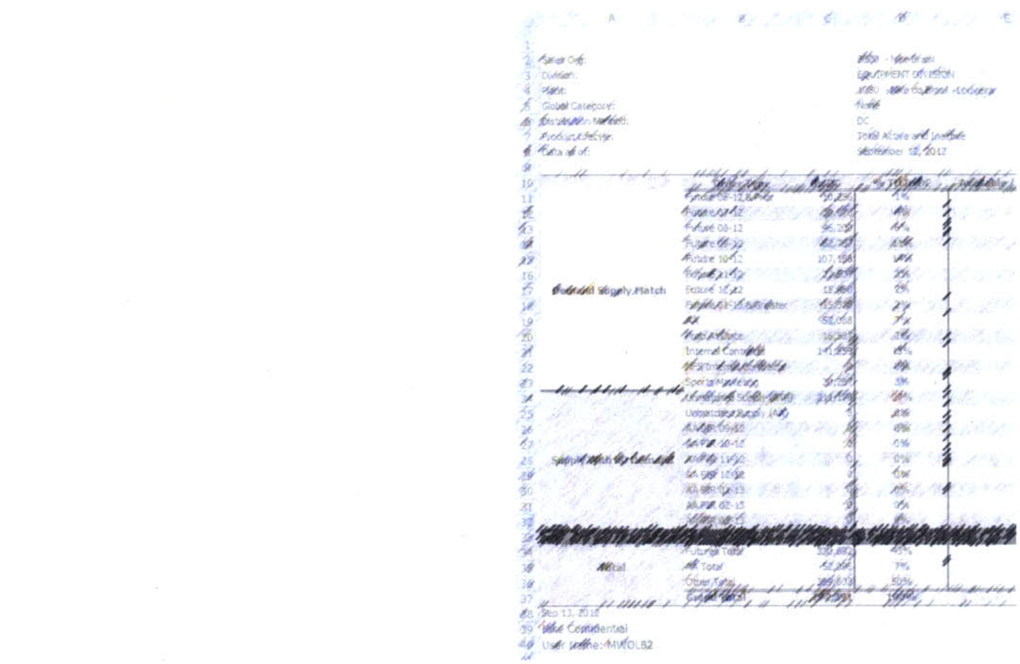

Figure A.22. Second Page Example of Inventory Flow Reports

2. The second page of a flow report will list actual units by order type. For geographies other than Europe and North America, the user can obtain the percent breakdown of inventory using these reports or by going directly to inventory managers in each geography. These numbers can go directly into the excel files under the “inputs” tab. DFCs are automatically calculated in the spreadsheet.
3. For Europe and North America, the DFC can be calculated as follows:

Example:

Snapshots for the end of each month is ideal, since it is in the middle of the shipping window. This provides the best average inventory for a DC. Historical data is even better to compare ending inventory levels.

Active (not discount) Non-RR MTO: this information can be found on the 3rd tab of an inventory flow report, which is considered the Active inventory in the DC. Similarly to the above snapshot cell C34, the total active MTO inventory can be determined by inspecting the 3rd tab of the report. There are separate tabs for Nike Retail Stores, both Inline and NFS. Subtract the MTO orders listed in these tabs to avoid double counting MTO orders (these are listed in the DTC portions of the model).

Using Non-RR MTO inventory units from the inventory flow reports and average shipment information taken directly from the Shipments tabs, the DFC can be calculated as follows:

$$\text{Eqn 1.} \quad DFC_{Non-AA\ Futures} = \frac{Non-AA\ Futures\ inventory\ units\ (minus\ DTC)}{Average\ FY13\ shipments\ per\ day}$$

In more general terms:

$$\text{Eqn 2.} \quad DFC = \frac{inventory\ units}{FY13\ shipments\ total} \times 365\ days$$

The second way to show updated DFC information or inventory efficiency improvements in the model is to keep the current DFCs from FY12 and apply percent improvements for specific years in the future business levers tab. This method requires validation using the output DSI. The user must check the output tabs to ensure that the improvements for specific years match average DSIs for those years.

Shipments Update

To update shipments in future years, the method of downloading SRI information is the same. However, for a full model refresh, the shipments for FY12 and FY13 can be eliminated entirely and overwritten by FY13 and FY14 information. This requires all of the years in the model to move ahead by one (Any FY12 headers are now FY13 headers). For this refresh, the entire FY13 year needs to be completed (similar to how FY12 was complete for this model). That way, DFCs can be calculated more accurately. FY14 can still be ongoing; however, the user must beware that the shipment information for DTC is not forecasted in SRI. In this case, the corrections for each geo must be taken from Revolution. With that being said, there is a plan to have DTC information forecasted in SRI in the near future. It is expected that this will take place before the next model refresh.

Appendix B - Tab Names

1. **Main:** Navigation page to main tabs
2. **Model Description:** Brief overview of the model
3. **(Geography Name) Inputs:** Information used in conjunction with shipments to determine DFC values. Not used in Europe and North America
4. **Current State Input:** Interim calculations from the Inputs page. Input pages for Europe and North America.
5. **Future Business Levers:** Input page for projections. Growth variables are applied to shipments for each inventory type, while improvement opportunities are applied to inventory levels. Air / Ocean / Truck transit split can also be modeled.
6. **(Geography Name) Forecasts:** Shipment forecasts for information not forecasted in SRI
7. **Total Shipments:** Summation of Apparel, Footwear, and Equipment shipments tabs
8. **Tt_DFC Cal:** Equivalent DFC information for the total geography
9. **Tt_DSI Calcs_DFC SL:** Summation of Apparel, Footwear, and Equipment structural limit DSI tabs
10. **Tt DSI Calcs_DFC Actual:** Summation of Apparel, Footwear, and Equipment actual DSI tabs
11. **Tt DSI Calcs_DFC Optimal:** Summation of Apparel, Footwear, and Equipment optimal DSI tabs
12. **Tt DSI Calcs_DFC Future_Actual:** Summation of Apparel, Footwear, and Equipment future actual DSI tabs
13. **Tt DSI Calcs_DFC Future_Optimal:** Summation of Apparel, Footwear, and Equipment future optimal DSI tabs
14. **Total Summary:** Summary of geography DSI information
15. **Total Graphs:** graphical representation of geography DSI information
16. **Total Financial Impact:** financial impact of optimal DSI
17. **AP SRI:** Shipment and Inventory inputs for Apparel
18. **AP DFC Assumptions:** apparel DFC calculation page using shipments and inventory input pages

19. **AP Shipments:** Apparel shipment information calculated using SRI and Inventory Input information
20. **AP_DFC Cal:** DFC values for apparel
21. **AP DSI Calcs_DFC SL:** apparel structural limit DSI calculation using shipments and DFC assumptions page
22. **AP DSI Calcs_DFC Actual:** apparel actual DSI calculation using shipments and DFC assumptions page
23. **AP DSI Calcs_DFC Optimal:** apparel optimal DSI calculation using shipments and DFC assumptions page
24. **AP DSI Calcs_DFC Future_Actual :** current state apparel DSI projections using DFC assumptions, shipments, and future business levers tabs
25. **AP DSI Calcs_DFC Future_Optimal:** optimal state apparel DSI projections using DFC assumptions, shipments, and future business levers tabs
26. **AP Summary:** DSI summary for apparel
27. **AP Graphs:** graphical representation of apparel DSI output
28. **AP Financial Impact:** Financial impact of optimal inventory levels for apparel
29. **FW SRI:** Shipment and Inventory inputs for footwear
30. **FW DFC Assumptions:** footwear DFC calculation page using shipments and inventory input pages
31. **FW Shipments:** Footwear shipment information calculated using SRI and Inventory Input information
32. **FW_DFC Cal:** DFC values for footwear
33. **FW DSI Calcs_DFC SL:** footwear structural limit DSI calculation using shipments and DFC assumptions page
34. **FW DSI Calcs_DFC Actual:** footwear actual DSI calculation using shipments and DFC assumptions page
35. **FW DSI Calcs_DFC Optimal:** footwear optimal DSI calculation using shipments and DFC assumptions page

36. **FW DSI Calcs_DFC Future_Actual :** current state footwear DSI projections using DFC assumptions, shipments, and future business levers tabs
37. **FW DSI Calcs_DFC Future_Optimal:** optimal state footwear DSI projections using DFC assumptions, shipments, and future business levers tabs
38. **FW Summary:** DSI summary for footwear
39. **FW Graphs:** graphical representation of footwear DSI output
40. **FW Financial Impact:** Financial impact of optimal inventory levels for footwear
41. **EQ SRI:** Shipment and Inventory inputs for equipment
42. **EQ DFC Assumptions:** equipment DFC calculation page using shipments and inventory input pages
43. **EQ Shipments:** Equipment shipment information calculated using SRI and Inventory Input information
44. **EQ _DFC Cal:** DFC values for equipment
45. **EQ DSI Calcs_DFC SL:** equipment structural limit DSI calculation using shipments and DFC assumptions page
46. **EQ DSI Calcs_DFC Actual:** equipment actual DSI calculation using shipments and DFC assumptions page
47. **EQ DSI Calcs_DFC Optimal:** equipment optimal DSI calculation using shipments and DFC assumptions page
48. **EQ DSI Calcs_DFC Future_Actual :** current state equipment DSI projections using DFC assumptions, shipments, and future business levers tabs
49. **EQ DSI Calcs_DFC Future_Optimal:** optimal state equipment DSI projections using DFC assumptions, shipments, and future business levers tabs
50. **EQ Summary:** DSI summary for equipment
51. **EQ Graphs:** graphical representation of equipment DSI output
52. **EQ Financial Impact:** Financial impact of optimal inventory levels for equipment
53. **AP Opt Inv Plan:** Outline of apparel improvement opportunities to determine optimal DFC

54. **FW Opt Inv Plan:** Outline of footwear improvement opportunities to determine optimal DFC

55. **EQ Opt Inv Plan:** Outline of equipment improvement opportunities to determine optimal DFC