Technical Memorandum #2

Final Report

Cotton Flow Study

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Preface

The purpose of this Technical Memorandum is to summarize Wilbur Smith Associates' research, analysis, and hypotheses that formed the background for Working Papers #1 through #6 and the two Hypotheses Papers. The last two chapters of this Technical Memorandum present final recommendations, strategies and techniques for reducing costs and improving competitiveness of cotton flows from post-bale formation to arrival at textile mills.

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Chapter 1: Cotton Flow Study

Introduction

The cotton flow study is a component of the Vision 21 initiative, a comprehensive effort of the National Cotton Council, Cotton Council International and Cotton Incorporated aimed at gaining critical information about cotton's position and potential in the market place. The purpose of the study is:

1. to research and survey the various segments of the cotton industry from bale formation to delivery of the bales to end-users
2. to prepare recommendations to improve data systems and merchandizing techniques to maximize domestic and international sales; and
3. to present strategies and techniques for improving warehouse efficiency and lowering transportation costs.

This is the cotton industry's opportunity to closely examine some issues that are really going to form the industries position over the next five-ten-fifteen years.

Structure of the Study

The study employed a range of data collection and analysis methods to understand and make recommendations aimed at improving the flow of cotton. The analyses performed and data collected are as follows:

1. The study team reviewed literature and economic data regarding the cotton industry to understand the competitive context within which the U.S. cotton industry finds itself and how this will impact the cotton flow.
2. Members of the NCC Vision 21 Cotton Flow Study Committee, as well as advisors to the committee, and allied industries were asked for their own ideas and opinions of how to improve the flow of cotton. These were provided as a series of "hypotheses" or preliminary guidance to assist the study team's investigation.
3. The study team surveyed each segment of the cotton industry, as well as allied industries. The feedback was gathered through both phone interviews and online surveys. Respondents were asked a range of questions regarding cotton flow issues, as well as to comment on the strengths, weaknesses, opportunities and threats that face the industry.
4. The preliminary findings based upon industry feedback were presented at the NCC's Annual Meeting on February 4, 2010. Each of the hypotheses was assigned a preliminary score, and attendees at the Vision 21 Cotton Flow Study Committee meeting were invited to comment on the initial scoring. Based upon this feedback, through subsequent outreach, and analysis of industry data, the study team further assessed each hypothesis to determine its likely impacts on cotton flows and ease of implementation.
5. The study team also analyzed cotton flows using Global Insight's 2008 TRANSEARCH database. This database helped the team to understand current and forecasted future flows

of cotton from production areas to final consumption location. For exports, this included the country of destination as well as the gateway port through which cotton flows.

6. The study team assessed changes within transportation, including shifts in transportation equipment usage, new port developments, and how these developments could impact the cotton flow and the cotton industry.
7. Cotton flows were also analyzed using the Texas A&M University least cost flow model. This model analyzes cotton logistics and transportation, assigning cotton flows to logistics paths that create the least cost in terms of transportation and storage. The model helped the study team to understand the impact of a variety of changes to cotton's logistics environment, as well as changes resulting from differences in logistics practice.
8. Finally the cotton industry was compared to other industries. This included a comparison of the cotton export supply chain to that of the hardwood lumber industry and the grain industry. Cotton data systems and warehousing practices were also compared to those used in the retail sector, as well as a range of other industries.

Based upon the data collection and analysis, the study team prepared a series of recommendations for the cotton industry. These were categorized as follows:

- Merchandising;
- Data methodologies;
- Warehousing and Shipping; and
- Transportation.

Chapter 2: Cotton Flow Study Research and Analysis

The first part of this Technical Memorandum discusses the research efforts of the study team to understand the issues surrounding cotton flows and to propose potential solutions.

Literature Review on U.S. Cotton's Competitive Situation

Among the first components of the study was a review of data and literature in order to understand the competitive context and economic issues that face the cotton industry. To a large extent, much of the data gathering for this project had already been performed by the NCC staff, which compiled *An Overview of the U.S. Cotton Industry*. The study team augmented the data provided in this document with additional research. Based upon the team's review of cotton industry data and the document provided by the NCC, some features of the cotton industry's economics and competitive situation are apparent:

1. The U.S. cotton industry has become more dependent upon exports in recent years. In the 2001/2002 marketing year, exports exceeded domestic mill use in U.S. cotton disappearance for the first time. Export growth continued to rise and contributed 73 percent of total disappearance in the 2007/2008 marketing year. In the U.S., 610 textile mills have closed since 1997. Some industry observers believe that the U.S. domestic textile industry has finally stabilized. China, Turkey, Indonesia, and Mexico are the most important export markets for U.S. cotton. In 2008/2009 China imported over twice the volume of U.S. cotton as any other country.
2. Price trends over the past several years have not been favorable to the U.S. cotton industry; although NCC forecasters believe that there will be a production increase in the 2010/2011 season. U.S. cotton production peaked in 2005/2006 at over 22 million bales and has since declined. Production in the 2008/2009 marketing year was 12.8 million bales. To some extent, these declines relate to farmers reacting to low cotton prices and higher prices for alternative crops competing for planting acreage. The NCC forecasts an increase in production to 15.5 million bales for the 2010/2011 marketing year.[1]
3. Competition with producers in other countries is fierce. China and India are the world's largest producers and spinners of cotton. These two countries have increased their market share of world cotton production from 35 percent in 2000/2001 to 55 percent in 2009/2010. They increased production by 27 million bales between 2000 and 2009 compared to a 9 million bale decrease for the rest of the world.
4. Government intervention plays a vital role in the cotton marketplace, not only in the United States, but also in other cotton producing and consuming regions all over the world. Governments dictate the financing of cotton, minimum prices, export bans, import tariffs, when producers can sell, when mills can buy, as well as a variety of other influences. These sudden influences have major market implications.

[1] Dale L. Cougot of the National Cotton Council (NCC), "Planted Acreage Report.", 2010 American Cotton Producer's Annual Meeting.

5. Some evidence suggests that the costs of producing cotton in the United States are on average higher than in other countries.[2] However, not all production regions in the U.S. were found to have higher costs than other regions in competing countries.
6. Studies suggest that U.S. cotton is in some ways more desirable than that of other countries. The USDA classification system is unique and is not found in other countries. U.S. cotton is among the least contaminated cotton growths. **Exhibit 1** shows a comparison of contaminants by country.[3]

Exhibit 1: Contaminants by Country of Origin (Pounds per Ton)4

Country	1999-2000	2004-2005	2006-2007
Australia	0.0028	0.0038	0.0012
United States	0.0056	0.0040	0.0028
China	0.0044	0.0060	N/A
Brazil	0.0064	0.0054	0.0048
West Africa	0.0074	0.0140	0.0050
Uzbekistan	N/A	0.0182	0.0048

The U.S. cotton industry has access to a better transportation network than is available in other production countries. For example, the World Economic Forum each year questions over 12,000 business executives about the quality of transportation infrastructure in various countries around the world.[5] Respondents are asked to rate the quality of infrastructure from 1 being extremely underdeveloped to 7 being extensive and efficient by international standards. As can be seen in **Exhibit 2**, the United States scores are higher than other top cotton-producing countries in terms of infrastructure quality.

[2] Rafiq M. Chaudhry of the International Cotton Advisory Committee (ICAC), "Cost of Production in the U.S. and Other Countries", *2005 Beltwide Cotton Conferences.*

Scott Rozelle of Stanford University, Mechel S. Paggi and Fumiko Yamazaki of California State University, Fresno, *Cost of Cotton Production in People's Republic of China.*

[3] International Textile Manufacturers Federation. "Cotton Contamination Survey" 2007. Accessed at: http://www.cottonusaturkey.com/uploads/9CottonContaminationSurveys1999-2007.pdf

[4] Apac International and CSIRO Textile and Fiber Technology. "Vigilance Will Ensure Cotton Remains Contaminant Free." 2008.

[5] World Economic Forum, *The Global Competitiveness Report 2009 – 2010.*

Exhibit 2: Infrastructure Ratings of Cotton Producing Countries

Country	Quality of Roads	Quality of Port Infrastructure	Quality of Railroad Infrastructure
United States	5.9	5.7	4.8
China	4.2	4.3	4.1
India	3.1	3.5	4.5
Pakistan	3.7	4	3.1
Brazil	2.8	2.6	1.8

If there is a consistent theme to be derived from the study team's review of literature on cotton economics, this is that U.S. cotton cannot afford to be complacent. Foreign producers in India and China have been increasing their market share. Particularly in India, there is ample potential to increase yields and production. Infrastructure and financing options continue to improve in these other countries.

Hypotheses

Members of the NCC's Vision 21 Cotton Flow Study Committee were asked to provide hypotheses at the committee's meeting on September 29, 2009. These "hypotheses" are ideas to reduce costs associated with cotton flows from bale formation to the end user. Members of the committee, as well as committee advisors, submitted one to two sentence statements explaining specific cotton flow/logistics phenomena that should influence the scope of the study. These were established in order to provide guidance to the consulting team as well as to ensure that all possibilities are under review. The hypotheses are listed below and are broken out into various categories, including marketing, bale selection/EFS, storage patterns, bale location ID, scheduling, data fields, minimum flow standards, fungibility and storage credits.

The consulting team of Wilbur Smith Associates and John Robinson of Texas A&M University has also proposed hypotheses, based upon their experience with transportation, logistics, and supply chain management in various other industries.

Hypotheses are sequentially numbered from 1 through 32. In the following section, they are described as introduced to the team in October 2009. In Chapter 7, Hypotheses are converted into a series of recommendations and a revised discussion is presented including an evaluation as to whether a hypothesis should be acted upon or considered by NCC as a low, medium or high priority and if a hypothesis should be pursued in the short, medium or long-term. In Chapter 7, the hypotheses retain their original number sequence; however, the location in the text may have been changed to fit the topic of discussion.

Marketing (1 – 4)

Hypothesis 1: Initiate longer buying and selling strategies by better using the futures market and on-call contracts; this should even out flow patterns.

Hypothesis 2: Initiating new trading units could improve handling of bales. As opposed to the current practice of pulling single bales, the possible breakouts would be: 1) a CLOB, or four bale clamp load of bales or one ton of cotton; and 2) a MARK/container load of 85 to 88 bales. Adopting either of the latter two approaches, even at the CLOB level, would improve efficiencies at the warehouse dramatically and reduces bale touches greatly. Adopting the full block method would reduce handling, personnel and equipment needs, and eliminates the need to pull individual bales from a block which results in about a ten foal increase in efficiency.

Hypothesis 3: An overall marketing strategy should be incorporated into the cotton industry including specific bale information (HVI), storage, service and price. The key is the synergistic effects between the various partners, including all entities in the flow channel versus the current practice of the seller mandating the partners. For example, a gin would identify a warehouse based on incentives versus the mill or shipper based on service.

Hypothesis 4: Set an industry standard on export shipments that improve Animal and Plant Health Inspection Services (APHIS) documentation processes.

Engineered Fiber Selection-EFS (5 – 6)

Hypothesis 5: The benefits of using EFS to blend loads and manage inventory is greater than the cost associated with the additional handling at warehouses. EFS gives U.S. cotton an advantage over growths in other countries.

Hypothesis 6: Benefits of using EFS for marketing and improving mill costs and performance can be enhanced if EFS will incorporate greater transparency of bale information such as specific warehouse location (i.e., within facility, within shed, within row/block) and software code to optimize balancing mill/shipper needs with bale location such that the bales can be optimally pulled from the closest and most efficient proximity location.

Storage Patterns (7 – 8)

Hypothesis 7: The customary practice of block stacking hinders the warehouse's ability to provide timely service and results in the shippers' need to re-concentrate into another warehouse.

Hypothesis 8: The information link between producers, shippers, and ginners should provide warehouses with bale status (i.e., contracted, open, pool) before the bales leave the gin so that the warehouse can make informed put-away/storage decisions.

Bale Location ID (9)

Hypothesis 9: The cotton industry should adopt a standard method of maintaining exact bale location information along with other important bale receipt data. The system should be flexible to accommodate all major storing methods and stacking and handling systems. To handle a flexible location code system, 'translational' software should be developed and employed which in turn would generate a "universal location code" internal to the software source code. A universal code could be used by all shippers and warehouses without disrupting current best-available warehousing practices. The universal translator will be functional across all storage procedures and shipper use would be inherent in shippers' EFS bale selection programs. One possibility would be to implement a numeric system similar to those used for the international trading harmonized schedule codes where some digits are fixed and some are flexible.

Scheduling (10 – 13)

Hypothesis 10: Smaller shippers who rely on freight forwarders are at an electronic disadvantage as the freight forwarder does not have access to the EWR scheduling device. To remedy this situation, a parallel/mirror provider system may be warranted with limited data availability.

Hypothesis 11: Increase efficiency, reliability and speed while cutting costs by communicating with logistics firms (i.e., truckers, railroads, etc.) electronically via the internet instead of by fax and phone.

Hypothesis 12: Make better use of the current scheduling tools provided, such as the EWR, Inc.'s provider systems 03 (Maintain Regular Receipts), 21 (Shipping Order Instructions & Receipts), 23 (Update Shipping Order) and 31 (Early Shipping Order) files.

Hypothesis 13: Provide incentives for warehouses who allow early shipping orders (ESO) such as: 1) enact substantial per-bale penalties for pulling bales from an ESO; 2) submit the ESO in a manner that minimizes congestion in load-out areas and facilitates pulling of other shipping orders or early shipping orders; and, 3) use a tool to keep bales at country warehouses until a final destination is determined.

Data Fields (14 – 15)

Hypothesis 14: Sharing of classing data between the bale deposition holder and the physical holder of cotton should be allowed under a confidentiality agreement to assist in storing practices.

Hypothesis 15: After some allotted number of months (12 to 24), the warehouse should be able to access all data fields with regard to the bales left in the warehouse so the warehouse can clear its books and better manage its space.

Minimum Flow Standard (16 – 19)

Hypothesis 16: By increasing the minimum shipment standard from 4.5 percent to a higher threshold of 6.5 percent, the improved availability, and thus merchantability, of U.S. cotton will be increased such that the aggregate bale value is greater than the combined increased costs for maintaining standby contingencies to meet the infrequent need to load at a greater level.

Hypothesis 17: Teams of custom pullers/stagers/loaders (similar to custom harvesters) could be utilized by groups of warehouses or supplied by shippers to assure timely preparation of cotton for shipment and reduce costs.

Hypothesis 18: Eliminate rebates or incentives that allow warehouses to attract cotton for the storage revenue and not the marketing advantage of it.

Hypothesis 19: Flow would be increased if shippers picked up shipments from warehouses in a more timely fashion.

Fungibility (20 – 23)

Hypothesis 20: There is a notion that certain quality and grade ranges can be grouped into similar categories so that limited substitution could be facilitated.

Hypothesis 21: Measure and determine a bale's relevant quality characteristics at the gin. The gin measured quality parameters would be used for marketing, storing, shipping and processing when EFS or similar lay-down systems are used.

Hypothesis 22: If individual bale data was put in broader terms (fewer categories) the handling savings would be greater than the efficiency loss in processing.

Hypothesis 23: Creating incentives and/or eliminating disincentives for keeping cotton bales in initial receiving warehouses until needed by textile mills (domestic and overseas) would generate industry cost savings thus eliminating unneeded handling, movement and transportation.

Storage Credits (24 – 25)

Hypothesis 24: Storage credits add value and options during times of low prices that are crucial to U.S. cotton participating in world trade. If storage credits are lost, U.S. cotton will not be price competitive in times of world excess supply.

Hypothesis 25: Cotton in the loan can impede the orderly flow of cotton to the end user.

Wilbur Smith/Texas A&M Hypotheses (26 – 32)

Hypothesis 26: The cotton industry could benefit by commissioning a study or several study sub-sets to design and field test various warehouse layout alternatives. The actual mock-ups would undergo statistical time/motion, feasibility/ease of use, and cost/benefit analysis. The goal would be to have one or a few alternative layouts vetted by small and large warehouse operators. This would help set guidelines for best practice standards not only for storage and lay down areas, but also bale location management, racking technology, Warehouse Management Systems (WMS) systems, etc. The results could be incorporated as an update for NCC's "A Guide for Cotton Bale Standards" or become a new stand-alone document. The benefit would be the creation of a standard developmental platform to enable eCotton and other warehouse software and business processes to be developed to work within a range of similar cotton warehouse layouts. Participants in this program would benefit from the resulting efficiencies from storage through merchandizing and shipping. The over-arching program could be managed as a think-tank with a dedicated test facility, and this would require financial and marketing support.

The program could draw upon the resources of universities, similar to the gin segment, which created the "cotton engineering, ginning and mechanization" chair at Texas A&M University. A cotton warehousing and logistics chair at a major university could be identified that would take on the responsibilities of carrying out the types of studies to test warehousing best practices.

These practices could be communicated to the industry by "warehouse and logistics schools" to accelerate technology transfer in the cotton warehousing and logistics industry. An agency, possibly the USDA ARS Office of Cotton Technology Transfer and Education, could work with the NCC and the cotton warehouse associations to develop the curriculum for warehousing/logistics schools.

Cotton, Inc. could be asked to evaluate modeling cotton flow solutions at the gin and warehouse level that accommodates EFS picking requirements. Under this alternative, the scope of Cotton, Inc.'s activities could be expanded to not only research and promotion activities that directly benefit producers and organizations near the end of the supply chain (i.e. spinners and retailers); its resources also would be mustered to find solutions to the storage and logistic challenges on the raw cotton side of the supply chain.

Hypothesis 27: The cotton industry should investigate the feasibility of developing cotton warehouse multilevel racks. Given the low turnover at cotton warehouses, these racks would be designed to be as inexpensive as possible but with ample durability. These racks would have the following benefits:

1. Bales could be racked on multiple levels, thus increasing the storage density without necessitating block stacking and restacking after pulls;
2. Bales would not need to be moved or touched when attempting to access a specific bale in a pick list;
3. Bale locations would be more consistent, and bales could be easier to find;
4. Racks would be permanent, enabling slot identification which could be integrated into a uniform bale locations application;

5. Participating warehouses could have the permanent slot locations entered into a multi-user, multi-location WMS that would create a virtual inventory of the participants bales;
6. With more consistent locations, warehouses would be better able to develop optimized picking strategies.

Hypothesis 28: The industry should develop a series of best practices for developing pick orders and performing multi-order picks. These best practices would help warehouses determine the optimal paths that should be followed to fulfill orders in the most efficient manner possible. It could also help warehouses to optimally divide orders between pick lists. The industry also could develop a series of best practices in terms of reporting performance metrics. These performance metrics would help warehouses to evaluate their operating performance, that of their employees, as well as other supply chain partners. These best practices can be incorporated into warehouse usage of eCotton or other cotton warehouse software.

Hypothesis 29: A cotton industry test facility can explore the best way to stuff containers. A standard 40-foot ISO container holds 88 bales. Already entering use are 45-foot high cube containers that reach full volume cubic capacity with 104 or more bales. The goal would be to reduce the number of containers that are needed to ship a specified number of bales. At one less 45-foot container for 6+/- 40-foot containers, total shipping costs could be reduced. 40-foot containers can also be analyzed to determine the optimum stuffing configuration. After the stuffing configurations became an "NCC Standard Pack" the new format with appropriately classed bales in it could be marketed as a multi-unit product. Railroad companies will need to be involved because some may be hesitate due to the weight of the containers and load liability issues.

Hypothesis 30: Given that the cost of intermodal rail is typically somewhere around $0.010 per bale-mile, and the cost of trucking bales is closer to around $0.035 per bale-mile, the availability of nearby intermodal rail service is important to the cotton industry. The cotton industry should work to promote the availability of intermodal rail to shippers outside of major metropolitan areas, perhaps working with other agricultural interests to defray the costs of repositioning containers, ensuring container availability, etc.

Hypothesis 31: The cotton industry should support the development of a container stuffing facility adjacent to one or several of the major cotton intermodal hubs. This would enable cotton shippers to load the 45-foot high cube containers at the terminals. Otherwise, these containers would be too heavy to legally travel over local roads and highways. These containers would lower the per bale cost of shipping, particularly for the Mid-South cotton shippers.

Hypothesis 32: The industry could support a forward distribution point in Northern Asia, Southern Asia and perhaps in the Eastern Mediterranean. These facilities, forward distribution points, could be fed by staging current sales and open bales for future sales. These facilities could buffer congestion shipping price increases. They also could allow shippers to take advantage of 45-foot containers, since these containers are not abundant and may not be available for moves that are not being pre-staged. After orders are placed by mills, delivery from the forward distribution centers would be in days or two weeks instead of six-plus weeks.

Industry Survey

After the initial formation of hypotheses, the study team received feedback from 108 members of the National Cotton Council, six foreign manufacturers **(Exhibit 3)** and various industry representatives from trucking firms, logistics firms, ocean carriers, railroads, software providers, and government agencies.[6] A series of phone and web-based survey tools were developed, which were customized for each cotton industry segment, as well as foreign manufacturers. Many of the questions of the survey tools overlapped across industry segments, so that producers, ginners, warehouses, manufacturers and merchants were asked the same questions. In other cases, questions were considered to be segment-specific and were only asked of those segments to which they were applicable. Respondents were asked about a range of issues that impact the flow of cotton. Respondents were also queried about their views of the strength, weaknesses, opportunities, and threats pertaining to their segments and the cotton industry as a whole.

Exhibit 3: Cotton Flow Survey Respondents

Segment	Producer	Gin	Warehouse	Merchant	Domestic Manufacturer	Foreign Manufacturer
Phone Interview	4	6	12	5	5	6
Online Survey	20	40	16	0	0	0

Source: Prepared by Wilbur Smith Associates

A number of the survey respondents identified business interests within multiple cotton industry segments. For example, a gin might also own a warehouse or a cotton cooperative may own business interests within several other cotton business sectors. Generally, each respondent completed one interview or survey, representing one segment of the industry. The surveys and interviews focused on two question categories:

- Questions regarding the strengths, weaknesses, opportunities, and threats (SWOT) facing the cotton industry; and
- Questions relevant to development of methods to improve the cotton flows.

Strengths, Weaknesses, Opportunities, Threats (SWOT Analysis)

The following is a summary of the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis from survey and interview responses, categorized by industry segment.

[6] This was not a statistical survey in that there was no methodology used to ensure the randomness of the sampling, which would allow one to draw statistical inferences regarding the industry as a whole. Those who participated were chosen for specific criteria to give feedback on the best and the broadest set of industry practices.

<u>Strengths</u>

Producers - Producers most frequently cited the quality of U.S. cotton and the reliability of delivery as important strengths. Other strengths cited:

- Efficiency of U.S. cotton production;
- High Volume Instrument (HVI) Testing system;
- Permanent Bale Identification (PBI) bar code system;
- Use of technology in U.S. cotton production;
- Education of producers and others in the industry; and
- Genetic seed technology.

Mechanized equipment, transportation capabilities, ginning, and warehouse systems also were mentioned. Still other respondents credited U.S. cotton with an adaptability and ability to change.

Gins - Similar to producers, the most common themes mentioned by ginners were the quality, cleanliness and consistency of U.S. cotton fiber. Also mentioned:

- Close relationships between growers and gins;
- Speed and efficiency of U.S. gins;
- Ability to adapt from year to year with a broad range of cotton harvests;
- Bale packaging; and
- Ability to ship in a timely fashion.

Increased efficiency was cited. Where gin's marginal costs remain level, they have benefited from economies of scale and that equips them to handle larger and larger volumes. Also cited were the availability of credit to the U.S. cotton supply chain and the usage of that credit to advantageously time the sales of cotton. One respondent noted improved ginning practices by curtailing over-processing fibers.

Warehouses - Similar to other industry segments, warehouse respondents cited the quality and reliability of U.S. cotton. Attributes mentioned:

- Overall quality control of the product;
- Product uniformity;
- Cleanliness of U.S. bales;
- Quality of bale packaging;
- High performance level of the U.S. warehouse infrastructure; and
- Customer support efforts of U.S. warehouses to ship in a timely manner.

Also noted was access to multiple good ports, the engagement of technology, and the well-funded nature of the industry.

Merchants – Similar to other segments, merchants cited:

- Quality and reliability of U.S. cotton;
- Low contamination with machine harvested cotton;
- Bales generally have less moisture than foreign bales; and
- U.S. cotton is reputable.

Merchants also mentioned the U.S. infrastructure and the ability to ship cotton anywhere in the world with short notice. One merchant mentioned that U.S. producers can store and ship cotton at any time, in contrast to many competitors overseas.

Domestic Manufacturers – The domestic manufactures mentioned the modern machinery used by the U.S. textile industry is quick and produces a consistent quality product. Another mentioned the consistency of U.S. cotton, as well as the reliability of the cotton supply chain.

Foreign Manufacturers – Foreign manufacturers were asked in what areas U.S. cotton has an advantage. Similar to U.S. respondents, foreign manufacturers mentioned the reliability and lack of contamination of U.S. cotton. The USDA's grading system was considered to be very important, with each bale being assessed. Another strength mentioned was the reliability of U.S. merchants to deliver cotton when promised.

Weaknesses

Producers – Several producers mentioned the cost of production within the U.S. as a primary weakness. Other weaknesses cited:

- Shipping costs is too expensive and less competitive;
- Diminishing local infrastructure; and
- The U.S. cotton infrastructure is set up for domestic processing, yet the industry increasingly ships overseas.

Several respondents highlighted the inability to influence Congress and/or regulatory bodies, particularly in regards to changing Intercontinental Exchange (ICE) certificated delivery points or warehousing situations. Still another respondent was concerned about supporting industries moving overseas.

Gins - Several ginners mentioned the relationship between cost and volume:

- Rising costs for labor, repairs, and utilities;
- Transportation expenses were too high;
- Inefficiencies as the length of haul increases between farm and gin;
- High cost of cotton production in the U.S. relative to the rest of the world; and
- As volume has declined, the corresponding per-bale cost of ginning has increased.

One ginner was concerned about fewer equipment manufacturers to provide replacement parts. Other issues cited were a lack of youth interest, the limited time that a gin can operate each season, and processing cotton in a timely fashion.

Warehouses - Warehouses noted a variety of weaknesses including:

- Double handling and double warehousing;
- Poor communication between shippers, truck lines, and warehouses;
- Long distances from warehouses to demand points; and
- Occasional slow pick ups at peak shipping times.

Also noted was the decline of a domestic market which had been a primary source of business a decade ago.

Merchants – Several merchants thought that price was the biggest weakness of U.S. cotton. Foreign mills buy inexpensive cotton from India, Pakistan and other sources and only buy U.S. cotton when these other sources are exhausted (however, not all merchants agreed that U.S. cotton is the cotton of last resort). Other issues included:

- U.S. cotton is stored in fragmented, non-strategic placement, timing/quickness is everything to mills;
- Ability of the U.S. to deliver cotton in a timely manner;
- U.S. cotton lint does not visually look as good;
- Staple is not as uniform; and
- Higher counts of short fiber, and higher neps.

One merchant mentioned that in the U.S., water is added during the ginning process. This is done for multiple reasons including improving ginning and to improve bale compression. In some rare cases, this is done just to make the cotton heavier, since producers are paid per pound. However, too much moisture during this process can discolor the cotton and causes it to deteriorate more rapidly. Shippers will penalize these gins once it is identified as an abuse.

Domestic Manufacturer – One domestic manufacturer mentioned high labor costs and the highly regulated labor environment in which domestic mills operate. Another domestic manufacturer mentioned the inefficiency of the U.S. cotton supply chain starting within the field so that cotton is then caught up in gins and warehouses before it arrives at his mill. He hopes to cut the inefficiencies. Cotton sits for too long. Another domestic manufacturer echoed concerns about the slowness of the U.S. supply chain.

Foreign Manufacturers – Several international manufacturers mentioned cost as the primary weakness of U.S. cotton. Another mentioned that U.S. mechanized harvesting leads to short fiber content relative to hand picked cotton. One mill complained about the neps content, the short fiber content, and high level of bark in U.S. cotton; the respondent did not believe that price was usually a problem, except for peaks in U.S. cotton markets, which he attributed to speculators.

Opportunities

Producers – Several producers mentioned opportunities in the technology and genetics of seed varieties including:

- Genetic modification for insect resistance, herbicide resistance, drought, and quality enhancement;
- Reductions in tillage were mentioned as a potential cost saving area;
- Optimization of warehouse and gin locations could represent an opportunity to remove cost from the cotton supply chain;
- Potential improved usage of gin byproducts and cotton seed;
- New module builder systems could be an opportunity; and
- Organic cotton niche market.

Several thought that there were opportunities in marketing, such as cooperatives taking a more active role in selling domestically and internationally directly to mills, increasing global per capita cotton consumption, or capturing more of the value of the textile end product through marketing.

Gins – Ginners cited several ideas that could be opportunities including:

- New uses for fiber, seed and gin byproducts as opportunity areas for increasing revenue;
- Development of smaller modules, which can be lifted onto a conventional flatbed trailer and hauled in quantities of two at a time, that are equivalent to one standard module;
- Increasing use of gin equipment technology;
- Improved bale packaging represents an opportunity; and
- Alternative energy as an opportunity (cotton byproducts can be mixed with an enzyme to generate heat, which can then be used to dry cotton).

A few other gins mentioned economies of scale, so that fewer larger gins could gin more cotton. Some believe that the larger, regional gins have a lower cost per bale.

Warehouses - Several warehouses cited bale handling as an area of opportunity including:

- Inbound grouping of bales;
- Bales could be categorized at the gin;
- Bale fungibility could lower costs (bales of like quality could substitute for one another);
- Usage of bale locator software (one respondent contended that warehouses could be 30 percent more efficient if all warehouses used locator software code);
- Elimination of rack samples; and
- Consolidation of the number and location of warehouses could save costs.

Labor was cited as a possible area where costs could be saved, with one warehouse arguing that robotics could be a solution while another mentioned the possible use of radio frequency identification (RFID) tags, as well as racking of bales as an opportunity.

Merchants - Merchants mentioned a range of opportunities including:

- Delivery of cotton in a more timely manner from port warehouses could increase U.S. cotton sales;
- Industry needs to reduce the basis (total cost of bringing cotton to the market);
- Additional government support to help with the price competitive imbalance situation could benefit the industry;
- One felt that the U.S. should be able to increase cotton yields;
- Minimizing the difficulty for obtaining letters of credit for foreign mills; and
- Standardizing and enforcing the sanctity of contracts with foreign buyers.

Others stated competing countries have been improving and the U.S. needs to continually improve as well since the global cotton market is price-driven.

Domestic Manufacturers – One domestic manufacturer mentioned a tighter integration of the cotton supply chain, so that the supply chain could mimic a vertically integrated company. Another mentioned reliable, just-in-time deliveries, so that mills do not need to maintain large warehouses. Another mentioned opportunities to cut costs, such as the number of times that bales are handled and shipped.

Foreign Manufacturers – Foreign manufacturers mentioned a range of opportunities to improve the competitiveness of U.S. cotton. One thought that U.S. gins should continue to improve their ginning processes to preserve the natural cotton fibers characteristics. Several suggested that the U.S. industry needs to reduce prices. Another felt that lead times should be improved.

Opportunities to improve warehouse functions and interaction with ginners/shippers will be discussed in much more detail in a later working paper.

Threats

Producers - Several producers felt that the relative cost of production between U.S. and foreign cotton growths is the primary threat to the industry. Other threats include:

- Increasing yields in competing countries due to the spread of U.S. technology that was originally paid for by U.S. producers and tax payers;
- Migration of the textile industry overseas;
- Low cotton prices causing the substitution of other crops;
- Environmental regulation;
- Weed resistance to herbicides; and
- Too much market power could be concentrated with several companies that control seed and chemical use.

Several were concerned about policy issues. For example, the Farm Bill is for only five years, and producers cannot make large capital decisions in that time frame.

Gins - Several ginners shared concerns similar to those of the producers:

- Environmental issues and pollution control requirements were the top threats facing the ginning industry;
- Ethanol support for grains;
- Substitution of other crops due to low cotton prices and higher prices for alternate crops;
- High input costs and labor issues, such as migrant labor laws, minimum wage, and national healthcare;
- Foreign competition; and
- Urban sprawl was also mentioned as a potential threat.

Some ginners were concerned about declining volume as well as dramatic shifts in annual supply and demand. One ginner in California felt that water issues, combined with regulatory agency policies, could put California cotton out of business.

Warehouses- Warehousemen cited several areas of potential threats including:

- Foreign competition from countries such as India and Brazil (greatest threat to the U.S. cotton industry);
- Educating foreign competitors about the U.S. cotton industry;
- Merchants moving cotton out of country warehouses;
- A multiplicity of small warehouses with few merchant warehouses; and
- Increasing cost of truck transportation.

Other threats mentioned were low cotton prices, trade agreements, high costs, and less flexibility because of fewer remaining warehouses.

Merchants - Merchants noted a number of threats to the U.S. cotton industry including:

- Foreign competitors increasing their production and dumping their cotton onto the world market;
- Improvements in Brazilian infrastructure;
- Increases in Indian cotton yields;
- Ability of foreign producers to obtain U.S. technology causing certain U.S. competitive advantages to diminish; and
- Concerns about U.S. farm policy and potential cuts in U.S. farm programs.

Several mentioned warehouse issues, including large stocks of cotton in interior warehouses or warehouses decreasing staff, both of which increase lead times.

Domestic Manufacturers – One domestic manufacturer mentioned foreign competition. Another stated that he wished we could level the playing field so that the U.S. textile industry competes on equal terms with foreign textiles.

Foreign Manufacturers - Several foreign manufacturers cited price as a threat to U.S. cotton. One noted the improved quality of Indian cotton, which will generate additional competition.

Cotton Flow Questions

In addition to questions regarding industry strengths, weaknesses, opportunities, and threats, cotton industry segments, as well as international mills were asked a series of questions pertinent to cotton flows.

Gins

The study team received responses from 46 companies from the ginning sector, and asked 27 questions focused on the following categories:

- Operation;
- Warehousing;
- Transportation; and
- Information System.

Operation

Among the 46 gins surveyed, 22 gins stated that they were affiliated with warehouses; 21 were involved in farming. **Exhibit 4** presents company affiliation and ownership categorization. Forty-two gin operators provided their company type. Over 30 percent are owned by a group of growers, while close to 29 percent stated that they manage a cooperative gin. Approximately 16 percent of the companies classified themselves as “other,” and 24 percent are privately owned.

Exhibit 4 also presents information on affiliations of these gins. Approximately 45 to 50 percent of the gins also are affiliated with farms, a warehouse, FOB merchant or a marketing cooperative. Around 11 percent of the gins also reported that they own oil mills or have a small piece of land and lease it out.

Exhibit 4: Type of Ownership and Affiliation

Ownership					
Cooperative Gin	Group of Growers	Private Ownership	Merchandising Firm or Oil Mill Ownership	Other	Total
28.57%	30.95%	23.81%	0.00%	16.67%	100.00%
Affiliated with the Following Enterprises					
Farm	Warehouse	Trucking Company	FOB Merchant	Marketing Co-op	Other
43.48%	50.00%	2.17%	43.48%	43.48%	10.87%

Source: Prepared by Wilbur Smith Associates

Forty-four gins reported their territory size. The average distance for gins to pick up modules is 23 miles, with the average longest distance of 55 miles. Over 60 percent of these responses have an average travel distance shorter than 30 miles.

Thirty gins responded to questions about whether the segment was consolidating. All agreed that this is a trend. In addition, 22 answered the questions regarding module harvesters and their potential to expand gins' territories. Over 60 percent of the responses were that pickers with onboard module builders would expand gin territories. Some respondents expressed doubt regarding the cost of fully adopting this equipment.

Exhibit 5 presents the operating characteristics of the gins. Almost 60 percent of the responses indicated that when scheduling modules for ginning, modules are ginned in blocks by grower or farm. Over 95 percent of the responding gins have one gin plant. The average number of growers who bring cotton to these gin plants is 41. These gins often process 12 kinds of seed varieties annually, and some gins process 30 to 40 types of seed varieties within a year.

Exhibit 5: Operations of Gin Plants

Module Process		Average number of gin plants	Average growers	Average Varieties of seeds
Sequentially numbered by gin (first come first served)	In blocks by grower/farm			
19	27	1	41	12

Source: Prepared by Wilbur Smith Associates

Warehousing

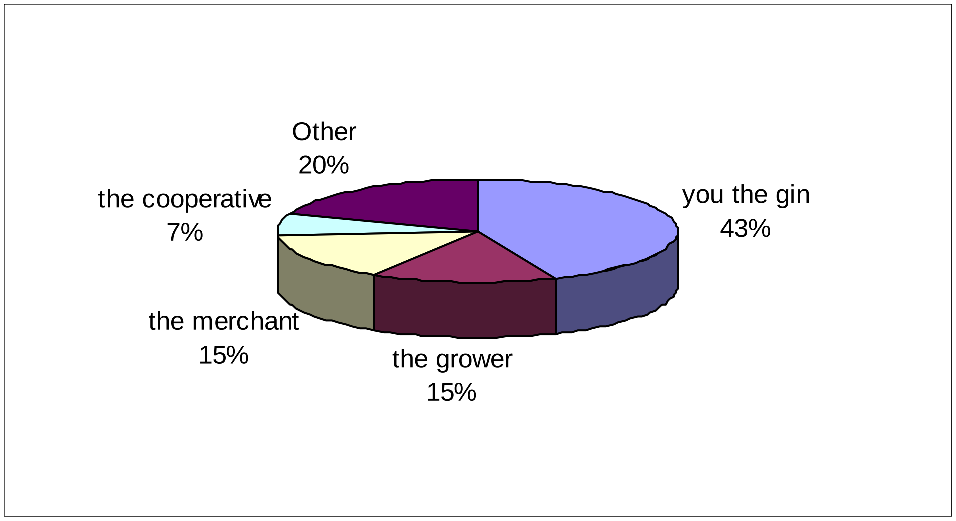
Over 65 percent of the gins send their bales of cotton to only one warehousing company, and the remaining gin plants send their cotton to two or three warehousing companies. As shown in **Exhibit 6**, among gins surveyed:

- 43 percent of the gins identify the warehouses where the bales are to be stored;
- 15 percent of the gins said that the choice of warehouse is determined by the growers;
- 15 percent said that the warehouse is determined by the merchant;
- 7 percent is by the cooperative network; and
- 20 percent of the gins have their own warehouses.

Gins were asked whether warehouses should have the right to review the ownership of bales in order to better manage their inventory:

- 15 out of 22 responses indicated that the warehouses should have this right at any time in order to manage their inventory.
- A few respondents said that the warehouses should have the right to review bales after 18, or 24 months; and
- 14 out of 20 interviewees believed that the producer should provide to the gin or/and warehouse bale sales status information before the bales arrives at the warehouse.

Exhibit 6: Who Indentifies Warehouses Where Bales Are to Be Sent



Source: Prepared by Wilbur Smith Associates

Transportation

The survey also asked questions related to cotton transportation. As shown in **Exhibit 7** more than 68 percent of the gins arrange transportation from gins to warehouses. Thirteen gins reported that they own transportation equipment, such as a dry van trailer or other truck trailer. The average transportation fee was $2.37 per bale. Over 70 percent of gins reported that the current transportation provider/ transportation infrastructure fully meets their needs.

Exhibit 7: Transportation from Gins to Warehouses

Gins Arrange Transportation		Own or Operate Transportation Equipment		Average Transportation Rate ($/bale)	Transportation Condition	
Number	%	Dry van trailer	Other truck trailer (e.g., flat-bed)		Fully meet needs	Not Fully meet needs
30	68.18%	10	3	$2.37	76%	24%

Source: Prepared by Wilbur Smith Associates

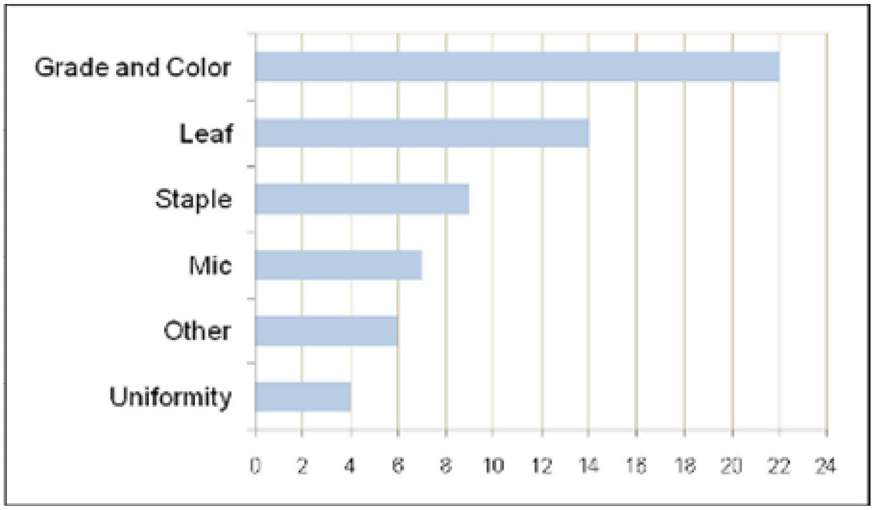
Industry Practices

Half of the respondents believed that the current USDA HVI grading system provides overly detailed information with regard to measuring fiber characteristics for the marketing of cotton. Fourteen gins did not agree that the grading system is overly detailed.

Exhibit 8 shows the opinions from the gins about potential fiber quality information that could be identified during the ginning process. Around 20 percent of the gin operators believed that quality information could be useful for marketing or pricing purposes. Between 10 percent and 15 percent of the gin operators thought that quality characteristics could help the procedures of slotting on arrival, picking and slotting for EFS on arrival.

Ginners were asked which lint quality characteristics that the ginner could provide information that would assist in marketing, slotting on arrival, picking and EFS procedures. As shown in **Exhibit 8** below, leaf and color were cited most frequently.

Exhibit 8: Gin-Provided Lint Quality Data, Which Could Improve Cotton Procedures



Note: Mic refers to micronaire.
Source: Prepared by Wilbur Smith Associates

In the current cotton marketing environment, the practice of measuring a wide range of distinct fiber characteristics appears to be necessary. There is a notion that following ginning, certain color-grade and quality characteristics could be grouped into similar categories so that limited substitution could be facilitated. Gins were asked to rate the impact of grouping on a range of different procedures with 1=little effect and 5=large effect. **Exhibit 9** shows the ratings that ginners applied to various functions in terms of the impact from quality groupings.[7] The shaded cells are those ratings which received the highest percentage of responses per procedure. The exhibit suggests that ginners felt that category grouping would have the highest impact on marketing and pricing.

[7] The specific wording of the question that ginners were asked was as follows: "*In the current cotton marketing environment, the practice of measuring a wide range of distinct fiber characteristics appears to be necessary because mills must produce a wide range of products or go out of business. There is a notion that following ginning certain quality and grade characteristics could be grouped into similar categories so limited substitution could be facilitated. How do you think this would affect the efficiency in the following?*"

Exhibit 9: Operating Tasks Affected by Grouping

Category	1	2	3	4	5	Total
Marketing	38.89%	11.11%	5.56%	5.56%	38.89%	100.00%
Pricing	38.89%	5.56%	5.56%	5.56%	44.44%	100.00%
Slotting	38.89%	11.11%	22.22%	11.11%	16.67%	100.00%
General Pulling	33.33%	27.78%	11.11%	5.56%	22.22%	100.00%
Shipping	63.64%	9.09%	9.09%	9.09%	9.09%	100.00%
EFS Pulling	13.33%	40.00%	13.33%	20.00%	13.33%	100.00%

Note: EFS refers to Engineered Fiber Selection
Source: Prepared by Wilbur Smith Associates

The survey also asked ginners about establishing subsets of bale data that would be accessible out of the provider system to various parties who have an active interest in the bale beyond the disposition holder (e.g., warehousemen, logistical firms, etc.). Most respondents did not answer this question. Several respondents proposed that owners, buyers and gins should pay for the information if they need it. Currently, USDA's guidelines do not allow the sharing of data except to the disposition holder or his agent.

Respondents were also asked about the potential of four bale case lots to improve flow. Eleven respondents agreed that the cotton flows would be improved if the industry were to adopt a standard of four bale case lots that facilitated grouping immediately following ginning, then maintained the bales as a case lot through the U.S. handling process and marketed the bales together as a case lot. Nine respondents did not believe this would help cotton flow. Those gins tied to warehouses that block stack favored this practice more than warehouses who row stack. When asked how "handling a case lot of 4 bales" would improve efficiency, most people believed that this action would improve efficiencies for pulling, staging, shipping and loading of bales. Impacts on marketing and slotting were deemed to be more moderate **(Exhibit 10)**.

Exhibit 10: Operating Tasks Affected by "A Case Lot of 4 Bales"

Category	1	2	3	4	5	Total
Marketing	33.33%	13.33%	20.00%	13.33%	20.00%	100.00%
Slotting	31.25%	6.25%	25.00%	25.00%	12.50%	100.00%
Pulling/Staging	18.75%	6.25%	6.25%	18.75%	50.00%	100.00%
Shipping	25.00%	6.25%	6.25%	18.75%	43.75%	100.00%
Loading of Bales	35.71%	0.00%	14.29%	0.00%	50.00%	100.00%

Source: Prepared by Wilbur Smith Associates

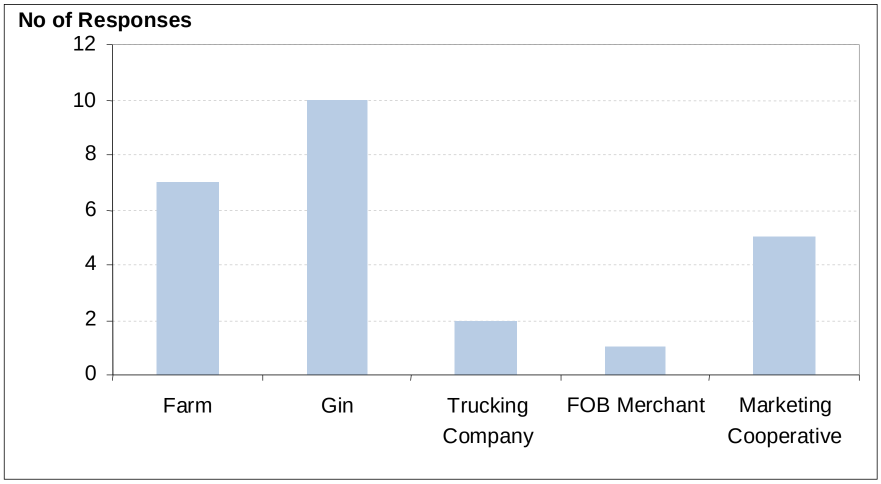
<u>Warehouses</u>

The survey collected responses from 28 representatives of the warehousing segment. The warehousers were asked questions focusing on operations, shipping and other industry practices.

Operation

Exhibit 11 shows the affiliations of warehouses with other business segments, including farms, gins and marketing cooperatives.

Exhibit 11: Warehouse Affiliations



Source: Prepared by Wilbur Smith Associates

The twenty eight warehouses indentified sources of cotton stored in their warehouses. As shown in **Exhibit 12**, most warehouses receive cotton from multiple gins or co-located gins. Some warehouses also received cotton from other warehouses.

Exhibit 12: Sources of Inbound Cotton

Sources	Co-located gin	Multiple gins	Other warehouses	Total
Counts	10	21	4	35
Share	28.57%	60.00%	11.43%	100.00%

Source: Prepared by Wilbur Smith Associates

Sixteen warehousers said that they are able to access temporary labor and/or equipment during the peak shipping periods. Respondents were asked how large an operation would need to be to make it feasible to have an in-house pool of laborers who could help to meet peak shipping demand. Responses varied. Several individuals mentioned capacities in bales, such as 100,000 or 200,000 bales. Some said that it is feasible to shift managerial staff, but not hourly labor.

Eight (or 36 percent) warehouse respondents use the block approach to stack bales in their warehouses compared to eighteen (or 64 percent) that use other approaches, mainly row stack.

Shipping

Exhibit 13 displays the average miles for the warehouses' inbound and outbound shipments. Inbound facilities are comparatively closer than consolidation centers, ports and mills.

Exhibit 13: Distances to Inbound and Outbound Facilities

Facilities	0-19 miles	20-49 miles	50-99 miles	100-199 miles	200 or more miles	Response Count
Inbound	21.74%	21.74%	34.78%	8.70%	13.04%	23
Consolidation Center	11.11%	22.22%	0.00%	33.33%	33.33%	9
Port	0.00%	0.00%	16.67%	33.33%	50.00%	12
Mill	9.09%	27.27%	9.09%	18.18%	36.36%	11

Source: Prepared by Wilbur Smith Associates

The survey also found that most cotton leaves warehouses by dry van or container. Relatively little inventory is now shipped by flat bed trailer or rail boxcar **(Exhibit 14)**.

Around 35 percent of respondents answered that bales are grouped in shippable lots at the time of sale, and another 46 percent said that the grouping of bales into lots is determined by the end users. Several respondents group bales into shippable lots while in the warehouse, and one respondent group's bales into shippable lots at the gin press.

Exhibit 14: Percentage Usage of Outbound Equipment

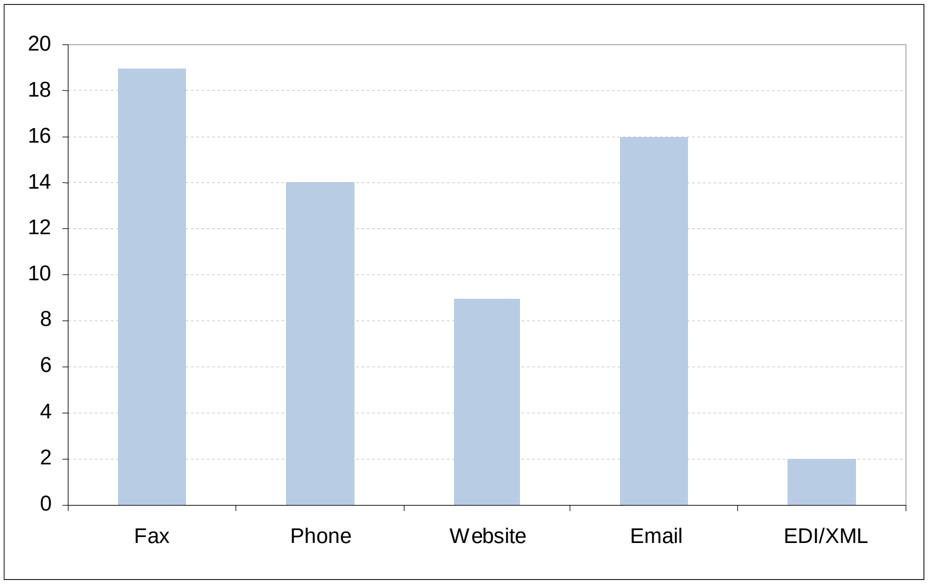
Shipping Method	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Response Count
Dry Van	15.79%	21.05%	5.26%	0.00%	21.05%	5.26%	5.26%	5.26%	10.53%	10.53%	19
Container	11.11%	5.56%	16.67%	5.56%	22.22%	11.11%	5.56%	0.00%	22.22%	0.00%	18
Flat bed trailer	16.67%	66.67%	16.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6
Boxcar	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1

Source: Prepared by Wilbur Smith Associates

As shown in **Exhibit 15**, most warehousers communicate with shippers by phone, fax, and email. Electronic data interchange (EDI) and extensible markup languages (XML) are used infrequently.[8]

[8] EDI and XML allow the computers of separate business entities to communicate directly with one another. EDI is a computer to computer exchange of business data that has to be mapped in standard formats between the sending and receiving applications. XML is a universal format for structured documents and data on the Web. EDI requires that users maintain a private, value-added network (VAN) while XML does not because it transmits over the internet. Being transmitted over the internet means XML documents typically need to be encrypted to maintain security. EDI has been used longer than XML.

Exhibit 15: Communication Method between Shippers and Warehouses



Source: Prepared by Wilbur Smith Associates

Eighteen warehouses reported that they have had problems with shippers not picking up outbound shipments. Responses suggest that the problem is rare and occurs only during the peak shipping periods. Respondents graded the efficiency of shippers. As shown in **Exhibit 16**, almost 50 percent of the warehouse operators thought that their shippers are highly efficient in terms of shipping and communication. Warehousers suggested that shippers could improve the flow of cotton by picking up bales on time, communicating better with warehouses and not overbooking.

Exhibit 16: Shippers' Efficiency

Rating	1	2	3	4	5	6	7	8	9	10	Response Count
Shipping	5%	0%	0%	5%	10%	0%	10%	35%	10%	25%	20
Communication	5%	0%	5%	5%	5%	11%	11%	26%	11%	21%	19

Source: Prepared by Wilbur Smith Associates

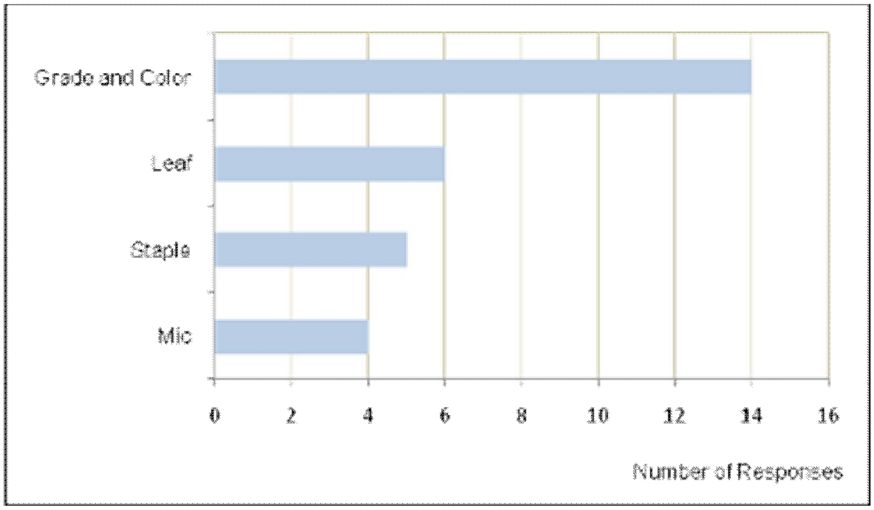
The survey asked if a 6.5 percent shipping standard were implemented, how this higher level would affect their operating cost. Some respondents estimated that their operating cost would increase by 20 to 30 percent.

Industry Practices

Nineteen of 25 warehouse operators surveyed believed that the current USDA HVI grading system provides overly detailed information with regard to measuring fiber characteristics for marketing of cotton, while six respondents did not agree that the grading system is overly detailed.

Warehousers were asked what lint quality characteristics they felt the gin could provide to assist in the marketing, slotting on arrival, picking and EFS procedures. As can be seen from **Exhibit 17**, fiber color-grade was considered to have the highest potential to improve these procedures.

Exhibit 17: Lint Quality Data



Note: Mic refers to micronaire
Source: Prepared by Wilbur Smith Associates

In the current cotton marketing environment, the practice of measuring a wide range of distinct fiber characteristics appears to be necessary. There is a notion that following ginning, certain quality and grade characteristics could be grouped by using less detailed data and placed into similar categories so that limited substitution could be facilitated. When the warehouses were asked about how the grouping would affect their operating efficiency, operators believed that the grouping would affect all the following procedures: slotting, general pulling, shipping and EFS pulling **(Exhibit 18)**. The impact on the general pulling and shipping is estimated to be slightly larger than slotting and EFS pulling.

Exhibit 18: Operating Tasks Affected by Classification Grouping

Category	1	2	3	4	5	Total
Slotting	18.75%	12.50%	12.50%	25.00%	31.25%	16
General Pulling	6.67%	0.00%	13.33%	33.33%	46.67%	15
Shipping	6.67%	0.00%	6.67%	40.00%	46.67%	15
EFS Pulling	25.00%	0.00%	8.33%	41.67%	25.00%	12

Source: Prepared by Wilbur Smith Associates

The survey also asked warehousers with regard to establishing subsets of bale data that would be accessible out of the provider system to various parties who have an active interest in the bale beyond the disposition holder (e.g., warehousemen, logistical firms, etc.). Among those who responded, most did not think it would be valuable for the warehouses. Only a couple said that it might be helpful.

Seventeen warehouse operators agreed that the warehouse flows would be improved if the industry was to adopt a standard of four bale case lots that facilitated grouping immediately following ginning, then maintained the bales as a case lot through the U.S. handling process and marketed the bales together as a case lot. Six respondents deemed that it would help the flows. When asked how "handling a case lot of four bales" is going to improve the efficiency, most believed this action would improve efficiencies for slotting, pulling/staging, shipping and loading of bales. However, it might have limited impacts on marketing **(Exhibit 19)**.

Exhibit 19: Operating Tasks Affected by "A Case Lot of 4 Bales

Category	1	2	3	4	5	Response Count
Marketing	54.55%	9.09%	18.18%	0.00%	18.18%	11
Slotting	30.77%	7.69%	7.69%	15.38%	38.46%	13
Pulling/Staging	5.26%	0.00%	21.05%	31.58%	42.11%	19
Shipping	11.76%	0.00%	17.65%	29.41%	41.18%	17
Loading of Bales	18.18%	0.00%	18.18%	27.27%	36.36%	11

Source: Prepared by Wilbur Smith Associates

As shown in **Exhibit 20**, sixty percent of the warehouse respondents thought that they could improve their storing, slotting and pulling if they had access to the provider system data, with a confidentiality agreement tied to the disposition holder. Eight warehouse operators did not see value for the warehouses to access this kind of data. About 70 percent of the warehouse respondents thought it would improve flow if producers provided gins and/or warehouses bale sale status information before the bales arrive at the warehouses.

Over 70 percent of the responses favor a standard method of maintaining exact bale location information. Some respondents said that they had the experience using existing locator software, and it improved the efficiency. About 65 percent of the responses favored the creation of a universal location code.

Exhibit 20: Additional Data for Improving Warehousing Efficiency

Should the warehouse with a confidentiality agreement tied to the disposition holder have access to additional data via the provider system to improve their storing, slotting, and pulling?	Yes		No		Response Count
	Number	%	Number	%	
	13	59%	8	36%	21
Should producers provide to the gin and/or warehouse bale sale status information (i.e., contracted and with whom, pool, co-op, open, etc.) before the bales arrive at the warehouse so it can make an informed put-away/storage decision?	Yes		No		Response Count
	Number	%	Number	%	
	13	72%	5	21%	18
Should the cotton industry adopt a standard method of maintaining exact bale location information (use of locator ID field on EWR) along with other important bale receipt data?	Yes		No		Response Count
	Number	%	Number	%	
	18	72%	5	20%	23
Should funding be allocated to create a universal location code translator based on current bale location codes regardless of storage procedures provided that the location code translator is accessible to shippers and mills for use in their bale selection programs including EFS?	Yes		No		Response Count
	Number	%	Number	%	
	13	65%	7	35%	20
What additional data would improve your handling of bales?					
Category	Number	%			
Quality	4	15%			
Prospective shippers' name	6	22%			
Destination	4	15%			
USDA loan status	4	15%			
Trucking firm	5	19%			
Logistics operations	4	15%			
Total=	27	100%			

Source: Prepared by Wilbur Smith Associates

Fourteen out of twenty warehouse operators believed that the Commodity Credit Corporation (CCC) loan premium and discount chart breaks out the cotton into more groups than is the common practice in the marketing of cotton, although some saw this level of detail as a competitive advantage for the U.S. cotton.

Seventeen warehouse operators believed trade rules or warehouse tariffs should be amended to allow warehouses to be compensated for expedited, special or priority orders. The remaining respondents did not express an opinion on this question.

Producers

Surveys and interviews were conducted with 24 cotton producers asking 26 questions focused on operations, gin & warehouse, transportation and other industry practices.

Operation

Interviewed producers have an average of 4,200 acres devoted to cotton. The smallest is 220 acres, and the largest is 18,000 acres **(Exhibit 21**). Approximately 50 percent of the respondents operated between 1,000 to 5,000 acres. Only two operated above 10,000 acres and only four operated less than 1,000 acres.

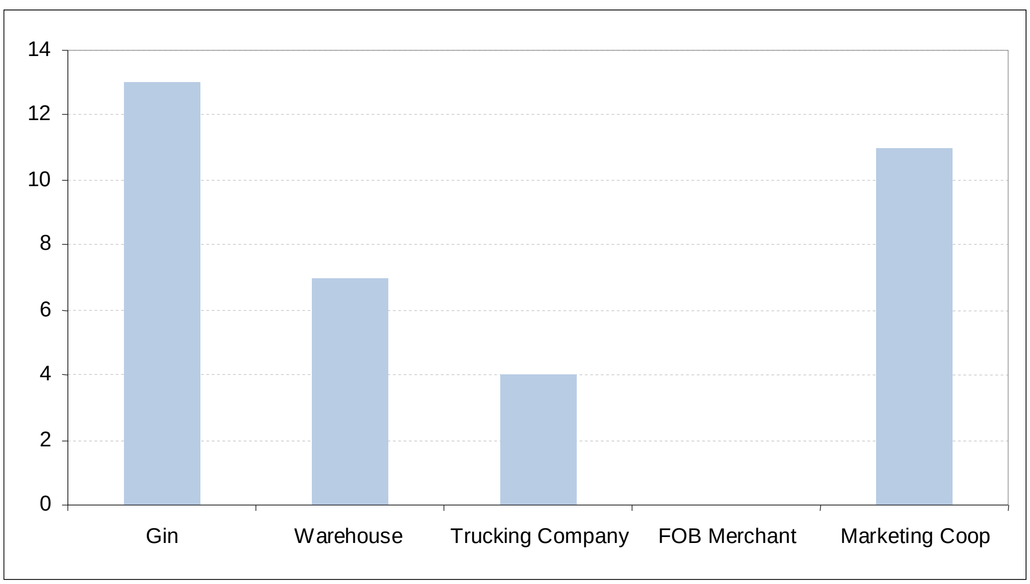
Exhibit 21: Size of Operation

	Response Count	%
Above 10,000 acres	2	9.09%
Between 5,000 and 10,000 acres	5	22.73%
Between 1,000 and 5,000 acres	11	50.00%
Less than 1,000 acres	4	18.18%
Total=	22	100.00%

Source: Prepared by Wilbur Smith Associates

Many producers stated that they had a business interests in ginning, warehousing, trucking line or marketing cooperatives **(Exhibit 22)**.

Exhibit 22: Producer Ownership Interests



Source: Prepared by Wilbur Smith Associates

Twenty three producers indentified their crops produced. Around 50 percent stated that cotton is their primary crop, with the production percentage ranging between 40 percent and 100 percent.

The average number of cotton seed varieties is around four. Some producers plant only one variety of cottonseed, while some plant as many as ten. Most producers store seed cotton using full modules, instead of half-modules or round modules.

Transportation

Ninety percent of the producers (22 out of 24) indicated transportation of seed cotton from field to gin is arranged by gins. The average transportation fee is between $45 and $100 per module. Most gins pick modules up for free as a marketing tool, or the fees have been included in ginning.

Nineteen producers graded their transportation providers or transportation infrastructures. In general, the producers thought the transportation is highly efficient and meets their needs.

Seventy five percent of the producers (18 out of 24) indicated that they were comfortable with marketing their bales in 84 to 88 bale lots.

Gin and Warehousing

Twenty-two producers indentified the number of gins available in their area. Most producers have three or more gins that they could take cotton to, although they usually use one gin, no more than two. As shown in **Exhibit 23**, around 83 percent of the producers use cooperative gins or private gins.

Exhibit 23: Type of Gins

	Response Count	%
Cooperatives where I am a patron	12	50.00%
Owned by a group of growers	4	16.67%
Privately owned	8	33.33%
Owned by cotton merchandizing firm or oil mill	0	0.00%
Total	24	100.00%

Source: Prepared by Wilbur Smith Associates

For most of the interviewed producers, modules are either processed by the gin in the order they are sequentially numbered (40 percent) or processed in blocks by grower/farm (60 percent). As shown in **Exhibit 24**, around 70 percent of producers' primary gins send the cotton to only one warehouse, and very few gins use more than two or three warehouses.

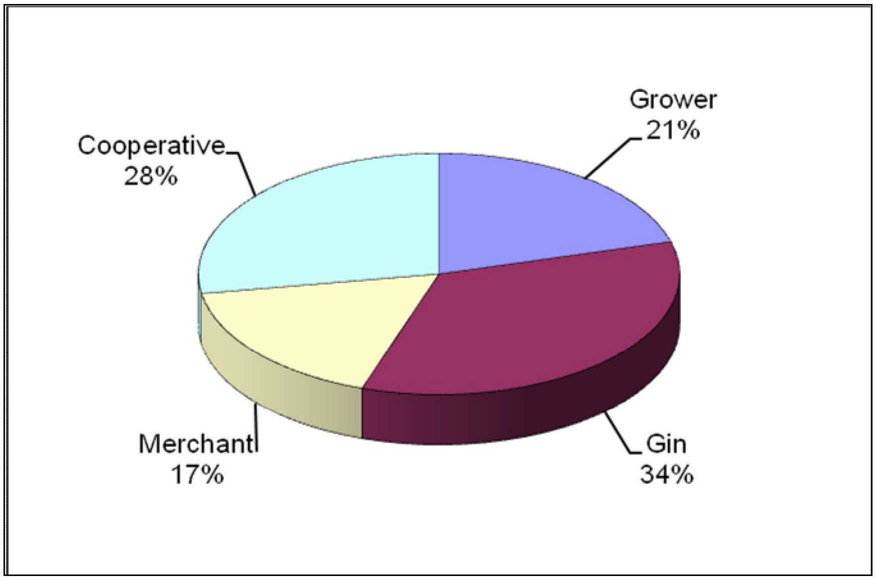
Exhibit 24: Number of Warehouse the Gins Use

Number of Warehouses	Response Count	%
1	16	69.57%
2	6	26.09%
3	1	4.35%
More than 3	0	0.00%
Total=	23	100.00%

Source: Prepared by Wilbur Smith Associates

Responses from thirty producers indicate that their gins most often choose the warehouses where the bales will be stored **(Exhibit 25)**.

Exhibit 25: Who Identifies the Warehouse where Bales will be Stored



Source: Prepared by Wilbur Smith Associates

Producers were asked about the value that warehouses provide. Over 35 percent of respondents thought the warehouses provide storage facilities until product are sold **(Exhibit 26)**. Around 20 percent of the producers believed the warehouses have more functions in terms of protecting the quality and enhancing the value of their product. Over 80 percent of the respondents believed warehouses increase the product's marketability.

Exhibit 26: Functions of the Warehouses

	Response Count	%
Storage facility until product is sold	18	36.00%
Protect the quality	12	24.00%
Enhance the value of my cotton bales	8	16.00%
Profit center	11	22.00%
Guardian of the electronic receipt	1	2.00%
Total=	50	100.00%

Source: Prepared by Wilbur Smith Associates

Exhibit 27 displays who are the original electronic warehouse receipt disposition holders. Over 40 percent of the producers said cooperatives are the original receipt holders, while 15 to 20 percent of the producers said that the ginners and warehouses are the original receipt holders. Some producers have more than one receipt disposition holders.

Exhibit 27: Original Electronic Warehouse Receipts Disposition Holder

	Response Count	%
The grower	2	7.14%
Agent	2	7.14%
Ginner	5	17.86%
CMA/LSA	1	3.57%
Warehouse	4	14.29%
Merchant (shipper)	2	7.14%
Cooperative	12	42.86%
Total=	28	100.00%

Source: Prepared by Wilbur Smith Associates

Marketing

Producers were asked who actively markets their cotton. Responses indicate that cotton was most often marketed in pools, followed by cooperatives **(Exhibit 28)**.

Exhibit 28: Who Actively Markets Your Cotton?

	Response Count	%
The grower	7	22.58%
Gin	0	0.00%
Warehouse	1	3.23%
Local FOB	1	3.23%
Pool	12	38.71%
Cooperative	10	32.26%
Total=	31	100.00%

Source: Prepared by Wilbur Smith Associates

Thirty percent of respondents prefer to sell cotton in a forward contract of greater than 6 months prior to harvest; while 50 percent indicated they prefer forward contracts less than 6 months. Around 20 percent of producers had a preference to sell after harvest in the spot market.

Around 30 percent of producers indicated that they contracted all the cotton in a marketing pool. A few producers noted that they enter into multiple contracts with merchants (shippers), local FOB buyers and marketing pools.

Most producers indicated they do not determine when the cotton is grouped for marketing. Close to 40 percent indicated that their cotton is grouped at the time of sale to the shipper, while 30 percent indicated that their cotton is grouped at the warehouses or as determined by the end users. The surveyed producers believe the timing of grouping into shippable lots is similar for sales to mills.

When asked how their open cotton was grouped for sale, over 35 percent of producers said their cooperatives handled that activity **(Exhibit 29)**. A few producers also responded that open cotton is grouped by either quality lots or by quoting a single, average price for a large number of bales.

Exhibit 29: How Open Cotton is Grouped for Sale

	Response Count	%
By farms	3	14.29%
Hog round (pool)	3	14.29%
By gin	0	0.00%
Total production	2	9.52%
Large blocks (i.e., 1000+ bale units)	0	0.00%
Small block units (i.e., module or dry van/container loads)	2	9.52%
By quality lots	3	14.29%
By the cooperative	8	38.10%

Source: Prepared by Wilbur Smith Associates

Merchants

Marketing

Merchants cited relatively short forward buying periods from foreign customers of one to three months. Cotton would either be sold at a spot price or sold at a contract rate, but for delivery no later than 90 days. Several reasons for this tendency were cited. Some mills source cotton to meet specific yarn contracts, which are also on spot contracts. Yarn mills enter into short term buying behavior because their own customers require them to do so. Spikes in commodity rates recently have also tended to moderate quickly, thus reducing the commodity price risk. One merchant mentioned that the current glut of cotton was such that mills could get what they wanted. Another merchant mentioned that many customers were traumatized by dramatic fluctuations in cotton prices that occurred in 2003 and again in 2008. They are reluctant to engage in long term contracts after these experiences. One merchant mentioned that mills will be more likely to engage in longer term, on-call contracts once a good relationship has been established between the merchant and the mill. Perhaps, as U.S. merchants increase their experience selling to foreign mills, contracts will naturally shift toward longer term on-call contracts. Other merchants did not see much opportunity for changing buyer behavior. One merchant felt that a bull market for cotton could help to push buyers into using longer term contracts.

Several merchants noted that they currently buy and sell some of their bales in trailer or container-sized lots. One merchant mentioned that his company currently sends case lots of a single farmer's cotton to Turkey. The Turkish mills separate the bales by grade. However, the Chinese mills tend to buy such large quantities of cotton that they need to buy shipments by specific grade. Another merchant mentioned that the company had previously tried to sell in case lots, but it did not work. Even when lots were sold from the same farmer/gin, the cotton could be inconsistent from one year to the next due to differences in weather, etc.

Storage Patterns

Several merchants indicated that block stacking hinders flow. However, the merchant responses did not appear to indicate that this was a very significant issue in and of itself. Some merchants indicated that hindrances to flow were more of an issue of warehouse management rather than specific stacking practices, per se.

Merchants were asked about the idea of industry-funded universal translation software that would allow exact bale location to be presented in a standardized format. Merchants did not respond strongly one way or the other. One merchant commented that his company currently uses bale location information from warehouses and was in favor of creating bale location translation software.

Scheduling

Merchants were questioned about whether interested parties should have access to the EWR system to improve scheduling. Some felt that it could be useful to make bale data available to interested parties in some circumstances. However, one respondent felt that the data was proprietary and would not want someone to see his inventory.

Some merchants thought that it could be useful if classing data were shared between the physical holder of a bale and the disposition holder in order to assist in storing practices. One representative of a merchant/cooperative was skeptical that this information could help to improve warehouse inventory management. The merchant noted that on some sales, the warehouse will not be pulling all the same grade, particularly with the EFS system. Under the EFS system, a range of grades could be pulled, as long as the overall inventory comes back to a specific average. The merchant also questioned what grade parameters the warehouse would use to group cotton and which parameter is a priority. Interestingly, no merchants objected to this proposal on the grounds that the data is proprietary.

Minimum Flow Standard/ Rebates and Incentives

Most of the merchants interviewed experience problems with warehouses imposing long delays to make cotton available.

Merchants were asked if they believed that rebates decrease the flow of cotton. One merchant did not take issue with rebates, since they represent the "free hand of the marketplace." One merchant considered flat direct rebates to be a major hindrance to cotton flow. He wished that merchants could direct cotton at the gin yard, so they could decide in which warehouses cotton would be stored. Instead, ginners usually decide where to store their cotton because they receive rebates. Competition for storage revenue is such that any warehouse that does not offer incentives to capture incoming bales is uncompetitive. This is an example of cost-escalating imitation and usually exists when there are large revenues in the market place, which occurred in the cotton industry with large rolling stocks[9]. At the same time, it is a competitive practice and over time a business cannot continue to operate if cost exceeds revenue.

Merchants were also asked about ways to develop an incentive structure for warehouses by shifting to charges focusing on the movement and handling of bales and less on the interval of time stored. One merchant felt that the market is already enforcing better service. Merchants bid lower for cotton from poor performing warehouses or avoid them entirely. Another merchant mentioned a number of ideas, such as paying warehouses a flat fee for storing cotton or changing the relationship between the shipping charge and the storage charge. One shipper noted that they have created alliances directly with some warehouses to improve overall service through better communications.

Fungibility

Most of the merchants interviewed believed that the current grading system provides an appropriate level of detail. This information is what the mill customers want and is a competitive advantage for U.S. cotton. They were generally uninterested in marketing cotton in general quality groups, although one merchant was supportive of the idea. One merchant did believe that the current level of detail was unnecessary and that gin-supplied quality data could help to sort bales at warehouses. It was also noted that this is similar to the selling practice of cotton by type.

Multiple Warehouses

Merchants were asked whether they operate consolidation warehouses and the percentage of shipments that are sent out of the consolidation warehouses. Each interviewee operates at least one consolidation warehouse. A range of responses, from 20 to 30 percent, indicated that shipments originated from consolidation warehouses. One merchant stated that his company maintains consolidation warehouses to guarantee supply when other warehouses are backed up. Another mentioned that the company needed enough bales at a single location to supply the grades necessary to fill orders.

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[9] U.S. stocks to total demand (use and exports) averaged 40% from 2004/05 to 2008/09; this implies only looking at these bales, they were most likely stored for a minimum of seven months.

Storage Credits

Shippers were asked whether they thought that the CCC loan program impedes cotton flow and whether they would change anything about the program. Several felt that the program reduces flow, while several felt that the program is essential and should not be changed. To some extent, this may reflect the difference in perspective between the marketing and logistic branches within cooperatives and merchants.

Domestic Manufacturer

Five domestic manufacturers were also interviewed. This study included 22 questions to the domestic manufacturers.

The domestic manufacturers produce yarn. These products are sold in the U.S. and also international markets, including China, Egypt and Central America. However, most U.S. yarn is sold in Mexico, Central America, and the Caribbean.

Interviewed domestic manufacturers buy most of their cotton from U.S. producers, such as from Memphis/Eastern and the San Joaquin Valley region. Some manufacturers import limited quantities of specialty cotton (ELS and organic) from Egypt and Turkey.

When they buy U.S. and international cotton, they usually contract with shippers (merchants and cooperatives), although one mill buys directly from gins/producers. Another mentioned that the company sources 60 to 70 percent of cotton from shippers directly and through The Seam indirectly, and a small amount directly from gins/producers. Domestic manufacturers use a range of contracting practices. Several rely both on year-long contracts, as well as shorter contracts. While the longer contracts provide a stable source of supply and quality, shorter term arrangements made after harvest can provide the potential for cost savings.

Some manufacturers felt comfortable with purchasing cotton in dry van/container sized lots, but some were not. One manufacturer mentioned that it would be unlikely for all bales in a case lot to meet his needs. It is better to select bales that specifically meet the mill's needs. One manufacturer mentioned that the company no longer maintains a distribution center and now relies on the warehouse industry to coordinate with the shipper to provide the service. Rather, lay downs are put together from several truck-loads. The company cannot maintain large volumes of inventory where they must sort through bales. Most manufacturers agreed that the adoption of a standard of four bale case lots that would be grouped immediately following ginning and kept together as a case lot would improve the cotton flows. It was considered important that the quality be nearly the same within the four bale case lots. This could be done since most bale lots would come from the same module and farm, although the first and last bale of a module would need to be monitored to ensure uniform four bale case lots. These end bales might likely be of mix qualities across two modules. One manufacturer mentioned that in the long term, he would like to see the industry move to 2,000 lb bales. Similar to the four bale case lots, this larger bale may experience similar quality issues across modules.

None of the manufacturers thought that the current U.S. cotton grading system produced overly detailed information. One mentioned that they formerly had to re-class bales, which increased their cost. Currently, the USDA HVI system is viewed as a cost savings. Several respondents thought that block stacking of bales by warehouses hinders cotton flow. Some domestic manufacturers also felt that storage credits in the CCC loan program hinder flow. Some manufacturers felt that rebates and incentives impede cotton flow. Some manufacturers favored a shift in the payment structure to warehouses, so that warehouses would be compensated for storage on a declining scale over a 12 month period. Under this approach, warehouses would have reasonable minimum and maximum revenues to cover their expenses.

Most domestic manufacturers felt that double warehousing can be justified. Several mentioned that the presence of shippers' consolidation warehouses enables them to receive just in time delivery, a very useful service. One mentioned that bales can be supplied within 48 hours if necessary. Another mentioned that shippers sometimes will move cotton because storage is less expensive when located closer to the southeastern mills.

Foreign Manufacturer

Most foreign manufacturers indicated that in the upcoming years, their companies will order the same or higher quantities of U.S. cotton as in the past. However, one company indicated that they may switch to Indian cotton due to the high price of U.S. cotton.

Responses regarding forward contracts were mixed. Some foreign manufacturers prefer the spot market, while others prefer forward contracts of varying lengths. Most companies have risk management policies in place to manage risks associated with currency and inventory. According to the responses, some companies buy options to reduce their price risk.

The interviewed manufacturers normally contract with merchants, although some also contract with cooperatives.

The interviewed manufacturers usually must work with lead times between one and two months from shippers, with most of the cotton obtained by these respondents originating from Texas. The responses indicated that they were willing to source more cotton from the U.S. if lead times from vendors improved.

When asked whether they would be comfortable buying in dry van/container sized lots of 84 to 88 bales for delivery, responses varied with some comfortable with the idea and others not.

Most respondents indicated that the U.S. grading system provides good information and that the system is not overly detailed. If cotton were grouped, respondents felt that the efficiencies would be most improved in marketing and pricing of U.S. cotton.

Cotton Flow Analysis: Domestic and International Trade Flows

Another component of the research conducted for the study was to analyze cotton flows using the Global Insight's Transearch™ database. This helps to enlighten the study team in its analysis of potential ways to improve cotton transportation and the cotton supply chain by understanding how cotton flow patterns currently occur and how they are forecasted to occur.

Data Source for the Study

Global Insights Inc.'s Transearch™ 2008 commodity movement database was purchased by the NCC for use in the Vision 21 Cotton Flow Study.[10] Transearch is considered the most comprehensive information source for domestic goods flows within the U.S., between North America Free Trade Agreement markets (NAFTA), and between the U.S. and overseas markets. NCC purchased Transearch 2008 at a state and business economic area (BEA) level for the Cotton Flow Study.[11] Transearch identified 2008 historic cotton flows and forecasted 2018 flows by tonnage and value between the cotton producing states, regions, BEAs, and markets, whether national or foreign, that received shipments.

In the U.S., a "running bale" or a physical bale of cotton weighs approximately 500 lbs. A "statistical bale" is the weight of the cotton lint minus the weight of the ties and bagging. Historically, the cotton lint weighed about 480 pounds and the tare weight of the ties and bagging was about 20 pounds. It is a standard practice to use 480 pounds for statistical purposes and that is the weight conversion that USDA uses when it reports bale counts in their balance sheets (i.e. supply, demand, exports, and ending stocks). For the Transearch analysis in the Cotton Flow Study, the bale count was calculated using 480 pound statistical bales to correspond to USDA convention. A conversion ratio of one long ton of cotton (2,240 pounds) equated to 4.59 bales.

For analysis of transportation issues later in this document, the running bale weight of 500 pounds is used because the combined weight of the lint and bagging must be accounted for in the calculation of transportation costs.

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[10] The TRANSEARCH™ dataset used to prepare this analysis was purchased from HIS Global Insights Inc.

[11] BEAs are designated by the Department of Commerce. They include a collection of counties that include an economic center.

Transearch's database tables were modified by WSA to include more precise data qualifiers about specific domestic locations for production and consumption, ports used for export, and foreign countries that receive the exports. This enhanced location specificity helped WSA to model the data for the Cotton Flow Study to determine how bales move between production regions and domestic and foreign markets.

The Transearch dataset is based on inputs from various government regulatory, economic and industry sources. As with any modeling activity, forecast totals depicted at a national or regional level are meant to provide cumulative direction. Transearch is a top down data model. Disaggregating cumulative international or national amounts into increasingly smaller subtotals to a state or BEA level can lead to slight misappropriations at the smallest level of measure. The exact amount and specific location of commercial activity are difficult to predict from national and international macro estimates. Also, the further into the future the study timeframe extends (10 years for this study), the less precision and certainty can be expected from the forecasts. As such, the forecast amounts should be considered only as guidance to identify distribution trends but not actual future amounts.

Cotton Producing Regions

Editing the Transearch data tables enabled WSA to align its flow analysis with the four standard cotton producing regions that are recognized by the NCC. Cotton production regions are listed from west to east:

- West: California, Arizona and New Mexico;
- Southwest: Kansas, Oklahoma, Texas;
- Mid-South: Missouri, Arkansas, Tennessee, Mississippi and Louisiana;
- Southeast: Virginia, North Carolina, South Carolina, Georgia, Alabama and Florida; and
- Other.

The total volume for shipments from the region labeled "Other" was less than 0.6 percent of the total bale volume and considered nonmaterial to the analysis. Although small compared to the total number of bales shipped, they were retained in the analysis to maintain the integrity of the totals. The Other region included the following states: Colorado, Iowa, Illinois, Indiana, Kentucky, Massachusetts, Maryland, Missouri, Nebraska, North Dakota, New York, Pennsylvania, Washington, and Wisconsin. These shipments are reviewed in more detail later in this section.

BEA Data Compared To County Data

BEA level data reflects commerce for metropolitan areas or for rural areas that have similar agricultural characteristics. Some BEAs are small in size such as BEA 30 which surrounds Charleston, SC, including Berkeley, Dochester, Colleton and Charleston counties. Other BEAs contain large areas like BEA 97 which is one of the largest and most populated because it includes Los Angeles, most of southern California and Arizona. Many BEAs are comprised of land areas that cross over state boundaries. For example, BEA 115 encompasses Columbus, Brunswick, New Hanover, and Pender counties in North Carolina; and Dillon, Darlington, Marion, Florence, Horry, Williamsburg, and Georgetown counties in South Carolina. BEA 11 contains counties from Alabama (4), Georgia (64), North Carolina (3), and Tennessee (9). South Carolina has only two BEAs that are located completely within the state's boundaries (BEA 30 and BEA 38). Four of South Carolina's BEAs straddle the state boundary with North Carolina and two BEAs straddle the state boundary with Georgia. That said, directly correlating cotton flows at a fine tolerance for South Carolina (or any state) as shown on the NCC's website[12] with BEA cotton flows from the Transearch™ database is not possible.

Forecast Comparisons

The Transearch™ 2008 actual volumes and 2018 forecast volumes were analyzed to calculate compound annual growth rates (CAGR) to compare the Transearch study against other cotton industry forecasts **(Exhibit 30)**. The Food and Agricultural Policy Research Institute (FAPRI) has research centers at Iowa State University and the University of Missouri – Columbia.[13] The FAPRI Outlook CAGR is similar to the Transearch forecast CAGR in that both predict an overall decline in bale consumption. One difference is that Transearch forecasts more of a decline in domestic consumption than the FAPRI Outlook. The Transearch and FAPRI forecast CAGR's differ from the USDA Outlook[14] in that the USDA Outlook forecasts a slight growth during the study period to capture approximately 35 percent of world cotton export trade by 2019.

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[12] State and County statistics are available on the National Cotton Council's website at http://www.cotton.org/econ/cropinfo/cropdata/county-db.cfm

[13] FAPRI prepares baseline projections each year for the U.S. agricultural sector and international commodity markets. The multi-year projections are published as FAPRI Outlooks, which provide a starting point for evaluating and comparing scenarios involving macroeconomic, policy, weather, and technology variables. These projections are intended for use by farmers, government agencies and officials, agribusinesses, and others who do medium-range and long-term planning. http://www.fapri.iastate.edu/about.aspx

[14] USDA Agricultural Projections to 2019 (OCE-2010-1), pages 40, 53, 63 and 75;

http://www.usda.gov/oce/commodity/archive_projections/USDAAgriculturalProjections2019.pdf

Exhibit 30: Comparison of Compound Annual Growth Rates

Transearch	Total	Domestic	International
2008	16.88	3.6	13.28
2018	12.64	1.44	11.12
CAGR	(2.9%)	(8.8%)	(1.8%)
FAPRI	Total	Domestic	International
2008	16.88	3.6	13.28
2018	13.89	3.16	10.73
CAGR	(1.9%)	(1.3%)	(2.1%)
USDA	Total	Domestic	International
2008	17.39	4.57	12.82
2018	17.92	3.92	14
CAGR	0.3%	(1.5%)	0.9%

NCC's 2009[15] projection also forecasts a positive CAGR for the next year as stocks decline and the industry responds to the global economic recovery.

Market projections are always uncertain, and agricultural, economic, and policy factors could change in unexpected ways that were not considered in the forecasts. When the economists at Global Insights (GI), the parent organization of Transearch; prepared their 2010 outlook, they predicted that competition for planting acreage from corn and soybeans could limit cotton's recovery in 2010. They projected 2010 cotton acres at 8.8 million, down slightly from 2009. At the time GI prepared its outlook, it anticipated U.S. cotton exports would struggle to increase even marginally and U.S. mill use would continue to dwindle. Based on information available at that time, with competition from corn and soybeans, GI considered that U.S. cotton acreage could dwindle to the 7.7-million-acre range by 2017, down from 15.3 million acres in 2006. In reality this may not occur, but the Transearch forecast was based on data trends from 2007/2008 and prior years, and on market perceptions from early 2009.

Transearch does provide a unique benefit in that it includes layers of transportation data that other forecasts do not. As such, it is a valuable tool to gain insight about transportation by commodity, origin and destination pairs, and by modes used.

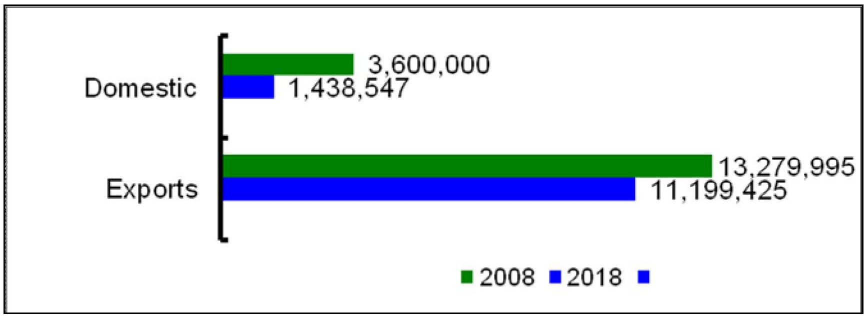
[15] National Cotton Council, 2009 Cotton Economic Outlook, http://www.cotton.org/econ/reports/annual-outlook.cfm

Cotton Flow Volumes

Based on the Transearch dataset, U.S. cotton producing regions shipped 16,879,994 bales in 2008 and are forecast to ship 12,637,972 bales in 2018 **(Exhibit 31)**. This forecast represents a decrease of approximately 25.1 percent over the next decade.

- Domestic volume was 3,600,000 bales in 2008, decreasing 60 percent to 1,438,547 in 2018; and
- Export volume was 13,279,995 bales in 2008, decreasing 15.7 percent to 11,199,425 in 2018.

Exhibit 31: Bales Shipped from U.S. Cotton Producing Regions

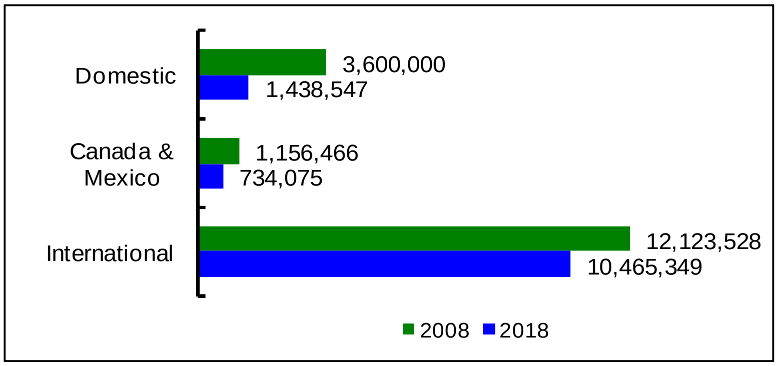


Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Annual totals are separated into three categories: domestic (between U.S. states); Canada and Mexico; and international (going to countries beyond North America). Reviewing the Transearch database, the 2008 base year and 2018 forecast, bale volumes by receiving markets are shown in **(Exhibit 32)**.

- Domestic volume was 3,600,000 bales in 2008, decreasing 60 percent to 1,438,547 in 2018;
- Canada's and Mexico's volume was 1,156,466 bales in 2008 decreasing 36.5 percent to 734,075 in 2018; and
- International volume was 12,123,529 bales in 2008 decreasing 13.7 percent to 10,465,349 in 2018.

Exhibit 32: Exports Separated for International and Canada and Mexico

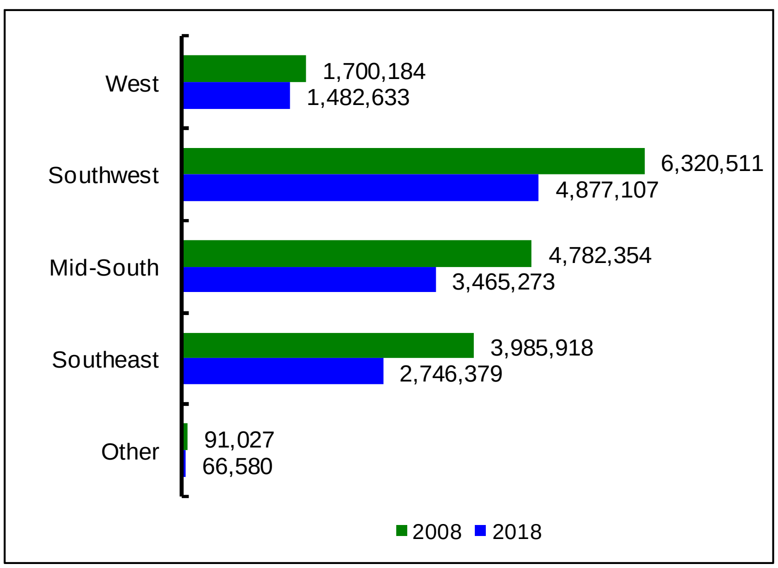


Source: Transearch 2008 Commodity Movement Database,
reported on 480 pound statistical bales.

Bale shipments for 2008 and forecast amounts for 2018, out of the cotton production regions, are shown in **Exhibit 33**.

- West volume was 1,700,184 bales in 2008, decreasing 12.8 percent to 1,482,633 in 2018;
- Southwest volume was 6,320,511 bales in 2008 decreasing 22.8 percent to 4,877,107 in 2018;
- Mid-South volume was 4,782,354 bales in 2008 decreasing 27.5 percent to 3,465,273 in 2018;
- Southeast volume was 3,985,918 bales in 2008 decreasing 31.1 percent to 2,746,379 in 2018; and
- Other volume was 91,027 bales in 2008 decreasing 26.9 percent to 66,580 in 2018.

Exhibit 33: Bales Shipped Out of Cotton Producing Regions



Source: Transearch 2008 Commodity Movement Database,
reported on 480 pound statistical bales.

Cotton Flows

The following exhibits **(Exhibit 34 through Exhibit 37)** indicate the cotton flows out of the four production regions into the different receiving regions or states. The exhibits show historic 2008 bale volumes, a forecast for 2018, and in the row below the 2018 forecast, the compound annual growth rate (CAGR) between the two periods. The right-hand columns calculate the share of the year's total volume and a running total of the cumulative share. Between tables, the cells with final totals may exhibit a very minor difference (one or two bales) due to rounding of decimal places during summation.

Domestic and International Cotton Flows

Domestic and export destinations are listed in **Exhibit 34**. In this table, U.S. domestic amounts are shown at the top, and export amounts are grouped below. Exports are subdivided in to Overseas and North American (bound for Mexico and Canada). For the Overseas' group there are 10 continental markets identified in the Transearch dataset. Totals for the cotton producing regions are at the bottom of the table. Overall combined domestic and export traffic for 2008 is at 16,879,994 (lower right corner of the table) and is forecast to decrease by 4.24 million bales for 2018 or slightly more than 25 percent. At 37.4 percent, the Southwest has the largest share of the producing regions followed by the Mid-South at 28.3 percent, the Southeast at 23.6 percent and the West at 10.1 percent. The top five markets comprise over 90 percent of the total share.

Exports to Asia have the largest share at 40.5 percent in 2008 and its share is forecast to increase to 47.2 percent in 2018 (right column). Asia's share grows not through an increase in volume but from less attrition compared to declining flows going to other markets. Exports to Asia are forecast to decline by 1.7 percent which is one of the smallest declines. Exports to the Indian Sub Continent are forecast to grow by over 200,000 bales or 23.1 percent. The Indian Sub Continent is the only export market forecast to grow. All of the other market areas experience declines, with Southeast Asia experiencing the largest decline at over 810,000 bales or almost 26 percent, the Middle East declining almost 680,000 bales or 33 percent and North America declining by more than 465,000 bales or 36.5 percent. Exports in the North America category include bale flows to Canada and Mexico that crossed the land borders as well as a minor amount that moved by water from Florida to Mexico.

Exhibit 34: Domestic and Export Cotton Flows

		Cotton Producing Regions						Share	
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
US Domestic	2008 Bales	345,966	805,408	1,109,608	1,330,777	8,240	3,600,000	100.0%	
	2018 Bales	165,784	339,058	467,797	462,841	3,067	1,438,547	100.0%	
	Change	(52.1%)	(57.9%)	(57.8%)	(65.2%)	(62.8%)	(60.0%)		
	2008 Regional Share	9.6%	22.4%	30.8%	37.0%	0.2%	100.0%		
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
Asia	2008 Bales	671,874	2,371,709	1,412,669	852,113	71,851	5,380,216	40.5%	40.5%
	2018 Bales	739,868	2,285,794	1,399,311	808,638	57,421	5,291,032	47.2%	47.2%
	Change	10.1%	(3.6%)	(0.9%)	(5.1%)	(20.1%)	(1.7%)		
Southeast Asia	2008 Bales	274,218	1,047,129	871,673	654,032	846	2,847,897	21.4%	62.0%
	2018 Bales	207,564	717,688	645,854	538,628	596	2,110,330	18.8%	66.1%
	Change	(24.3%)	(31.5%)	(25.9%)	(17.6%)	(29.6%)	(25.9%)		
Middle East	2008 Bales	49,611	791,382	402,697	622,340	416	1,866,446	14.1%	76.0%
	2018 Bales	32,986	559,435	235,112	422,314	305	1,250,153	11.2%	77.2%
	Change	(33.5%)	(29.3%)	(41.6%)	(32.1%)	(26.8%)	(33.0%)		
Indian	2008 Bales	184,885	237,669	163,425	207,384	203	793,567	6.0%	90.7%
Sub Continent	2018 Bales	231,104	268,522	186,845	290,056	277	976,804	8.7%	92.5%
	Change	25.0%	13.0%	14.3%	39.9%	36.4%	23.1%		
South America	2008 Bales	63,135	377,770	137,188	114,926	58	693,078	5.2%	95.9%
	2018 Bales	40,935	270,549	81,381	80,405	38	473,309	4.2%	96.8%
	Change	(35.2%)	(28.4%)	(40.7%)	(30.0%)	(34.7%)	(31.7%)		
Central America	2008 Bales	11,443	52,999	180,408	114,998	0	359,849	2.7%	98.6%
	2018 Bales	8,392	40,470	129,075	90,694	0	268,631	2.4%	99.2%
	Change	(26.7%)	(23.6%)	(28.5%)	(21.1%)	0.0%	(25.3%)		
Europe	2008 Bales	28,499	54,528	16,509	35,595	9	135,141	1.0%	99.6%
	2018 Bales	12,272	22,159	7,253	15,196	5	56,885	0.5%	99.7%
	Change	(56.9%)	(59.4%)	(56.1%)	(57.3%)	(52.3%)	(57.9%)		
Africa	2008 Bales	14,067	3,371	6,864	10,458	0	34,759	0.3%	99.9%
	2018 Bales	7,817	3,809	5,969	11,603	0	29,197	0.3%	99.9%
	Change	(44.4%)	13.0%	(13.0%)	10.9%	0.0%	(16.0%)		
Caribbean	2008 Bales	438	3,861	4,421	923	0	9,643	0.1%	100.0%
	2018 Bales	313	2,873	3,338	731	0	7,255	0.1%	100.0%
	Change	(28.6%)	(25.6%)	(24.5%)	(20.8%)	0.0%	(24.8%)		
Pacific	2008 Bales	6		1,769	1,159	0	2,934	0.0%	100.0%
	2018 Bales	4		935	814	0	1,754	0.0%	100.0%
	Change	(35.6%)	0.0%	(47.1%)	(29.8%)	0.0%	(40.2%)		
Overseas Total	2008 Bales	1,298,178	4,940,417	3,197,623	2,613,929	73,383	12,123,528	91.3%	
	2018 Bales	1,281,255	4,171,301	2,695,073	2,259,081	58,640	10,465,349	93.4%	
	Change	(1.3%)	(15.6%)	(15.7%)	(13.6%)	(20.1%)	(13.7%)		
	2008 Regional Share	10.7%	40.8%	26.4%	21.6%	0.6%	100.0%		
North American	2008 Bales	56,040	574,686	475,123	41,212	9,405	1,156,466	8.7%	
International	2018 Bales	35,594	366,748	302,404	24,457	4,872	734,075	6.6%	
(Mexico + Canada)	Change	(36.5%)	(36.2%)	(36.4%)	(40.7%)	(48.2%)	(36.5%)		
	2008 Regional Share	4.8%	49.7%	41.1%	3.6%	0.8%	100.0%		
International Total	2008 Bales	1,354,218	5,515,103	3,672,746	2,655,140	82,787	13,279,995	100.0%	
(Overseas +	2018 Bales	1,316,849	4,538,049	2,997,476	2,283,538	63,512	11,199,425	100.0%	
North American)	Change	(2.8%)	(17.7%)	(18.4%)	(14.0%)	(23.3%)	(15.7%)		
	2008 Regional Share	10.2%	41.5%	27.7%	20.0%	0.6%	100.0%		
Total US Bales	2008 Bales	1,700,184	6,320,511	4,782,354	3,985,918	91,027	16,879,994		
(Domestic +	2018 Bales	1,482,633	4,877,107	3,465,273	2,746,379	66,580	12,637,972		
International)	Change	(12.8%)	(22.8%)	(27.5%)	(31.1%)	(26.9%)	(25.1%)		
	2008 Regional Share	10.1%	37.4%	28.3%	23.6%	0.5%	100.0%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Canada and Mexico flows are broken out in a separate table **(Exhibit 35)**. Canada's share of the North American export volume is very small at approximately 3 percent or 35,701 bales in 2008. Canada's volume is forecast to drop by 44.2 percent down to 19,916 bales in 2018. Mexico's North American export volume was 1,120,766 in 2008 and is forecast to drop by 36.3 percent down to 714,159 bales in 2018. Exports to Mexico from the Southwest producing region is forecast to decrease by approximately 207,000 bales, the Mid-South by 172,000 bales and the West by 21,000 bales.

Exhibit 35: Export Cotton Flows to Canada and Mexico

		Cotton Producing Regions						Share	
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
Canada	2008 Bales	5,507	7,981	6,676	15,397	140	35,701	3.1%	
Border Crossing	2018 Bales	3,345	5,093	3,445	7,944	89	19,916	2.7%	
	Change	(39.3%)	(36.2%)	(48.4%)	(48.4%)	(36.4%)	(44.2%)		
Mexico	2008 Bales	50,534	566,705	468,447	25,815	9,265	1,120,766	96.9%	
Border Crossing	2018 Bales	32,249	361,655	298,959	16,513	4,783	714,159	97.3%	
	Change	(36.2%)	(36.2%)	(36.2%)	(36.0%)	(48.4%)	(36.3%)		
Total	2008 Bales	56,040	574,686	475,123	41,212	9,405	1,156,466		
	2018 Bales	35,594	366,748	302,404	24,457	4,872	734,075		
	Change	(36.5%)	(36.2%)	(36.4%)	(40.7%)	(48.2%)	(36.5%)		
	2008 Regional Share	4.8%	49.7%	41.1%	3.6%	0.8%	100.0%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Domestic Flows between Regions and States

Domestic shipments to states are listed in **Exhibit 36**. In this table, shipment amounts are shown for the top ten receiving states plus the remaining 18 states. Some states receive cotton for milling and other states receive cotton as a participant in supply chain movements. In 2008, the top five inbound states received 85.4 percent of the total bales shipped domestically, while the top ten inbound states received over 96 percent. For 2018, the share of the top five is forecast to drop to 77.9 percent while the share of the top ten receiving states drops to 91.5 percent. The decline for the top ten states from 2008 to 2018 is forecast to be 2,147,232 bales. The decline for all states during that same period is forecast to be 2,161,453 bales.

The biggest influence on this change is the decrease in shipments received by North Carolina whose share drops from 45.4 percent down to 19.9 percent as the state experiences an 82.4 percent decline in shipments. North Carolina's receiving volume in 2008 was 1,635,147 bales and is forecast to drop to 286,985 bales in 2018 as milling production migrates out of the area.

Other states with significant forecast declines are:

- Massachusetts declines by approximately 133,800 bales;
- Pennsylvania declines by approximately 257,500 bales; and
- California declines by approximately 168,000 bales.

Most of the other states also experience declines in receiving volume. Only nine of the remaining states experience minor increases, with a cumulative increase of 18,700 bales.

Below **Exhibit 36** is a breakout of the remaining 18 states shown in **Exhibit 37**. Mississippi, Florida, Arizona, and Alabama are producers of cotton. It is reasonable to assume that these states will have small amounts of inbound cotton that most likely will be used for milling, consolidations, or transloading. The other non-producing states can also have inbound cotton flows for milling, consolidations, transloading or for export or border crossings which will generate a second waybill record and appear as either an inbound or outbound shipment.

Exhibit 36: Domestic Cotton Flows from Producing Regions to Top 10 Receiving States

		Cotton Producing Regions						Share	
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
North Carolina	2008 Bales	108,921	285,552	505,432	731,742	3,501	1,635,147	45.4%	45.4%
(9 BEAs)	2018 Bales	18,215	47,822	90,477	129,891	580	286,985	19.9%	19.9%
	Change	(83.3%)	(83.3%)	(82.1%)	(82.2%)	(83.4%)	(82.4%)		
Massachusetts	2008 Bales	43,814	94,206	160,082	193,810	1,252	493,164	13.7%	59.1%
	2018 Bales	31,864	68,882	117,760	139,981	964	359,452	25.0%	44.9%
	Change	(27.3%)	(26.9%)	(26.4%)	(27.8%)	(23.0%)	(27.1%)		
Pennsylvania	2008 Bales	34,223	77,104	121,258	163,194	1,420	397,198	11.0%	70.2%
	2018 Bales	12,956	26,893	43,431	55,941	477	139,697	9.7%	54.6%
	Change	(62.1%)	(65.1%)	(64.2%)	(65.7%)	(66.4%)	(64.8%)		
Tennessee	2008 Bales	27,651	67,959	133,931	61,940	103	291,584	8.1%	78.3%
(8 BEAs)	2018 Bales	25,075	58,130	109,642	51,425	94	244,365	17.0%	71.6%
	Change	(9.3%)	(14.5%)	(18.1%)	(17.0%)	(9.1%)	(16.2%)		
California	2008 Bales	45,867	137,671	36,624	36,987	1,373	258,522	7.2%	85.4%
(7 BEAs)	2018 Bales	18,857	46,323	12,668	12,047	421	90,316	6.3%	77.9%
	Change	(58.9%)	(66.4%)	(65.4%)	(67.4%)	(69.3%)	(65.1%)		
Georgia	2008 Bales	6,867	37,109	35,085	47,495	24	126,581	3.5%	88.9%
	2018 Bales	1,649	10,526	8,772	11,074	8	32,029	2.2%	80.1%
	Change	(76.0%)	(71.6%)	(75.0%)	(76.7%)	(67.1%)	(74.7%)		
Ohio	2008 Bales	29,432	17,231	24,432	26,060	179	97,334	2.7%	91.7%
	2018 Bales	16,357	9,637	13,663	14,600	104	54,362	3.8%	83.9%
	Change	(44.4%)	(44.1%)	(44.1%)	(44.0%)	(42.0%)	(44.1%)		
Louisiana	2008 Bales	4,050	21,839	19,065	19,161		64,115	1.8%	93.4%
	2018 Bales	3,209	17,305	15,107	15,182		50,803	3.5%	87.4%
	Change	(20.8%)	(20.8%)	(20.8%)	(20.8%)		(20.8%)		
Texas	2008 Bales	3,940	24,477	18,331	9,856		56,604	1.6%	95.0%
	2018 Bales	1,928	12,308	8,922	4,663		27,821	1.9%	89.4%
	Change	(51.1%)	(49.7%)	(51.3%)	(52.7%)		(50.9%)		
New York	2008 Bales	4,356	6,675	16,962	14,571	28	42,591	1.2%	96.2%
	2018 Bales	3,031	4,948	12,652	9,134	13	29,778	2.1%	91.5%
	Change	(30.4%)	(25.9%)	(25.4%)	(37.3%)	(52.8%)	(30.1%)		
Remaining	2008 Bales	36,846	35,584	38,407	25,963	361	137,161	3.8%	100.0%
States	2018 Bales	32,643	36,285	34,702	18,902	407	122,940	8.5%	100.0%
	Change	(11.4%)	2.0%	(9.6%)	(27.2%)	12.8%	(10.4%)		

Total US Bales	2008 Bales	345,966	805,408	1,109,608	1,330,777	8,240	3,600,000
	2018 Bales	165,784	339,058	467,797	462,841	3,068	1,438,547
	Change	(52.1%)	(57.9%)	(57.8%)	(65.2%)	(62.8%)	(60.0%)
2008 Regional Share		9.6%	22.4%	30.8%	37.0%	0.2%	100.0%

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Exhibit 37: Total Flows from Producing Regions to Remaining 18 States

		Cotton Producing Regions						Share	
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
Michigan	2008 Bales	9,572	3,034	4,075	2,663	35	19,377	0.5%	0.5%
	2018 Bales	12,069	3,353	4,391	2,476	45	22,333	1.6%	1.6%
	Change	26.1%	10.5%	7.8%	(7.0%)	29.3%	15.3%		
Wisconsin	2008 Bales	11,063	4,288	5,631	5,960	38	26,981	0.7%	0.7%
	2018 Bales	5,589	2,167	2,845	3,012	19	13,632	0.9%	0.9%
	Change	(49.5%)	(49.5%)	(49.5%)	(49.5%)	(49.5%)	(49.5%)		
Mississippi (6 BEAs)	2008 Bales	464	6,136	4,970	1,106		12,676	0.4%	0.4%
	2018 Bales	668	8,840	7,160	1,593		18,262	1.3%	1.3%
	Change	44.1%	44.1%	44.1%	44.1%		44.1%		
District of Columbia	2008 Bales	961	1,638	4,154	3,672	5	10,430	0.3%	0.3%
	2018 Bales	773	1,318	3,327	2,902	4	8,323	0.6%	0.6%
	Change	(19.6%)	(19.6%)	(19.9%)	(21.0%)	(18.5%)	(20.2%)		
West Virginia	2008 Bales	4,502	2,488	3,752	3,805	18	14,565	0.4%	0.4%
	2018 Bales	1,233	682	1,028	1,042	5	3,989	0.3%	0.3%
	Change	(72.6%)	(72.6%)	(72.6%)	(72.6%)	(72.6%)	(72.6%)		
Florida (10 BEAs)	2008 Bales	558	1,081	3,145	2,448		7,231	0.2%	0.2%
	2018 Bales	473	956	2,755	2,095		6,279	0.4%	0.4%
	Change	(15.3%)	(11.5%)	(12.4%)	(14.4%)		(13.2%)		
Alabama (5 BEAs)	2008 Bales	191	3,100	1,305	933	2	5,531	0.2%	0.2%
	2018 Bales	245	3,982	1,676	1,198	2	7,103	0.5%	0.5%
	Change	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%		
Indiana	2008 Bales	2,676	954	714	0	10	4,354	0.1%	0.1%
	2018 Bales	4,580	1,856	1,184	0	18	7,639	0.5%	0.5%
	Change	71.2%	94.7%	65.9%	110.6%	71.3%	75.5%		
South Carolina (8 BEAs)	2008 Bales	347	779	2,053	2,519	4	5,703	0.2%	0.2%
	2018 Bales	315	708	1,865	2,288	4	5,180	0.4%	0.4%
	Change	(9.2%)	(9.2%)	(9.2%)	(9.2%)	(9.2%)	(9.2%)		
Arizona (5 BEAs)	2008 Bales	1,489	3,313	951	388	10	6,152	0.2%	0.2%
	2018 Bales	1,101	2,452	704	287	8	4,552	0.3%	0.3%
	Change	(26.0%)	(26.0%)	(26.0%)	(26.0%)	(26.0%)	(26.0%)		
Illinois	2008 Bales	2,242	1,465	581	0	9	4,297	0.1%	0.1%
	2018 Bales	2,684	1,753	696	0	11	5,144	0.4%	0.4%
	Change	19.7%	19.7%	19.7%	19.7%	19.7%	19.7%		
Maine	2008 Bales	758	972	1,934	1,379	4	5,047	0.1%	0.1%
	2018 Bales	443	567	1,129	805	2	2,946	0.2%	0.2%
	Change	(41.6%)	(41.6%)	(41.6%)	(41.6%)	(41.6%)	(41.6%)		
Missouri (11 BEAs)	2008 Bales	155	2,074	1,008	287		3,525	0.1%	0.1%
	2018 Bales	186	2,489	1,209	344		4,228	0.3%	0.3%
	Change	20.0%	20.0%	20.0%	20.0%		20.0%		
Idaho	2008 Bales	585	1,146	1,421			3,152	0.1%	0.1%
	2018 Bales	658	1,203	1,502			3,362	0.2%	0.2%
	Change	12.6%	5.0%	5.6%			6.7%		
Nevada	2008 Bales	397	1,580	266		6	2,249	0.1%	0.1%
	2018 Bales	517	2,058	347		8	2,930	0.2%	0.2%
	Change	30.3%	30.3%	30.3%		30.3%	30.3%		
Washington	2008 Bales	427	513	755	109	211	2,015	0.1%	0.1%
	2018 Bales	548	659	970	140	271	2,589	0.2%	0.2%
	Change	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%		
Maryland	2008 Bales	122	267	1,027	693	1	2,111	0.1%	0.06%
	2018 Bales	127	277	1,065	718	2	2,188	0.2%	0.15%
	Change	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%		
Utah	2008 Bales	338	756	666		7	1,767	0.0%	0.05%
	2018 Bales	432	967	851		9	2,258	0.2%	0.16%
	Change	27.8%	27.8%	27.8%		27.8%	27.8%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Outbound Flows From Producing States

Total outbound flows are listed in **Exhibit 38**. The study focuses on the main cotton producing states but there are a few areas that produce minor amounts of cotton or are listed as sources of shipments for various reasons and are labeled "Other" (explained in next section).

Exhibit 38: Outbound Flows of Cotton

		Cotton Consuming Regions						Area's Share
Destination	Data	Domestic	Asia	SE Asia	Mid East	All Other	Total	
Total for Cotton Producing States	2008 Bales	3,591,355	5,307,847	2,846,479	1,865,947	3,175,663	16,787,290	99.5%
	2018 Bales	1,435,286	5,233,013	2,109,339	1,249,805	2,542,668	12,570,113	99.5%
	Change	(60.0%)	(1.4%)	(25.9%)	(33.0%)	(19.9%)	(25.1%)	
Others	2008 Bales	8,645	72,369	1,418	499	9,773	92,704	0.5%
	2018 Bales	3,261	58,019	991	347	5,242	67,859	0.5%
	Change	(62.3%)	(19.8%)	(30.1%)	(30.4%)	(46.4%)	(26.8%)	
Total	2008 Bales	3,600,000	5,380,216	2,847,897	1,866,446	3,185,436	16,879,994	
	2018 Bales	1,438,547	5,291,032	2,110,330	1,250,153	2,547,910	12,637,972	
	Change	(60.0%)	(1.7%)	(25.9%)	(33.0%)	(20.0%)	(25.1%)	

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Outbound shipments from cotton producing states are listed in **Exhibit 39**. In the table, outbound shipment amounts are shown for the 17 states contained in the standard cotton producing regions. The producing states are listed alphabetically in the left column. The major consuming regions are listed along the top row, starting with US domestic, Asia (mostly China), Southeast Asia, Middle East (mostly Turkey), and a summary for all remaining regional flows. The table shows 2008 historic amounts and Transearch forecasts for 2018.

The majority of states are forecast to experience a negative compound annual growth rate (CAGR) for domestic and international shipments. Domestic shipments shrink by at least half for each of the states. Most states show a negative CAGR to Asia, Southeast Asia and Middle East.

However, by examining the table, there is considerable growth in volume from Arkansas to Asia and Southeast Asia. The growth is not indicative of a production increase in Arkansas. The increase may reflect growth in intermodal transport headed from the cotton producing area around Memphis to the ports in Los Angeles. Also, the growth is calculated using a low base number which is why the percentage is relatively large. Transearch forecasts intermodal growth in BEA 82 – Jonesboro, AR, which is on the western side of the Mississippi River. Transearch also forecasts a decrease in shipments of a similar amount from metropolitan BEA 105 – Memphis, TN-MS-AR. WSA's recent analysis showed that instead of locating a new planned intermodal facilities in BEA 82 (outside of Memphis), the BNSF, CN, CSX and NS have invested in improvements in their intermodal facilities within the Memphis metro area. BEA 105 could be adjusted upward, and BEA 82 could be adjusted downward based on new information when it becomes available about railroad developments in the Memphis metro area.

Other states experiencing growth are New Mexico with increased volume to China and Southeast Asia, and Virginia with increased exports to Asia.

Exhibit 39: Outbound Cotton Flows From States To Consuming Regions

		Cotton Consuming Regions						Area's Share
Destination	Data	Domestic	Asia	SE Asia	Mid East	All Other	Total	
Alabama (5 BEAs)	2008 Bales	183,373	97,690	33,700	25,720	75,667	416,150	2.5%
	2018 Bales	65,976	111,878	30,806	21,030	68,830	298,521	2.4%
	Change	(64.0%)	14.5%	(8.6%)	(18.2%)	(9.0%)	(28.3%)	
Arkansas (6 BEAs)	2008 Bales	390,695	51,298	46,820	92,731	239,550	821,094	4.9%
	2018 Bales	181,124	607,633	295,453	62,746	191,267	1,338,223	10.6%
	Change	(53.6%)	1,084.5%	531.0%	(32.3%)	(20.2%)	63.0%	
Arizona (5 BEAs)	2008 Bales	93,827	204,872	53,498	3,656	43,830	399,683	2.4%
	2018 Bales	38,852	197,755	35,451	1,724	33,300	307,081	2.4%
	Change	(58.6%)	(3.5%)	(33.7%)	(52.9%)	(24.0%)	(23.2%)	
California (7 BEAs)	2008 Bales	214,806	456,836	213,985	7,036	254,436	1,147,099	6.8%
	2018 Bales	112,268	426,259	134,625	3,253	247,762	924,168	7.3%
	Change	(47.7%)	(6.7%)	(37.1%)	(53.8%)	(2.6%)	(19.4%)	
Florida (10 BEAs)	2008 Bales	178,626	51,126	31,586	99,601	50,904	411,843	2.5%
	2018 Bales	64,160	77,041	48,241	80,058	57,296	326,796	2.6%
	Change	(64.1%)	50.7%	52.7%	(19.6%)	12.6%	(20.7%)	
Georgia (9 BEAs)	2008 Bales	471,477	428,470	320,177	316,300	198,910	1,735,334	10.3%
	2018 Bales	168,606	368,099	247,441	198,946	183,796	1,166,888	9.3%
	Change	(64.2%)	(14.1%)	(22.7%)	(37.1%)	(7.6%)	(32.8%)	
Kansas (6 BEAs)	2008 Bales	16,466	11,946	3,364	5,112	3,674	40,562	0.2%
	2018 Bales	4,299	11,800	2,383	3,566	2,320	24,367	0.2%
	Change	(73.9%)	(1.2%)	(29.2%)	(30.3%)	(37.5%)	(40.0%)	
Louisiana (7 BEAs)	2008 Bales	39,089	182,162	98,278	47,659	104,917	472,106	2.8%
	2018 Bales	13,929	190,781	83,419	28,666	78,679	395,473	3.1%
	Change	(64.4%)	4.7%	(15.1%)	(39.9%)	(25.0%)	(16.2%)	
Missouri	2008 Bales	112,992	21,818	22,171	6,458	30,234	193,672	1.2%
	2018 Bales	51,532	24,770	15,292	3,908	20,026	115,528	0.9%
	Change	(54.4%)	13.5%	(31.0%)	(39.5%)	(33.8%)	(40.3%)	
Mississippi (6 BEAs)	2008 Bales	194,299	56,393	19,686	72,006	170,085	512,468	3.1%
	2018 Bales	78,366	55,740	14,934	39,658	126,421	315,118	2.5%
	Change	(59.7%)	(1.2%)	(24.1%)	(44.9%)	(25.7%)	(38.5%)	
North Carolina (9 BEAs)	2008 Bales	351,872	195,711	239,481	115,303	154,224	1,056,591	6.3%
	2018 Bales	116,510	162,371	163,019	86,688	154,847	683,435	5.4%
	Change	(66.9%)	(17.0%)	(31.9%)	(24.8%)	0.4%	(35.3%)	
New Mexico (8 BEAs)	2008 Bales	37,333	10,166	6,735	38,919	60,248	153,402	0.9%
	2018 Bales	14,664	115,854	37,487	28,009	55,369	251,384	2.1%
	Change	1,039.6%	456.6%	(28.0%)	(28.0%)	(8.1%)	68.3%	
Oklahoma (8 BEAs)	2008 Bales	52,630	58,565	25,094	8,422	46,713	191,425	1.1%
	2018 Bales	20,302	56,770	17,806	4,710	29,430	129,018	1.0%
	Change	(61.4%)	(3.1%)	(29.0%)	(44.1%)	(37.0%)	(32.6%)	
South Carolina (8 BEAs)	2008 Bales	50,109	28,470	11,685	36,909	15,431	142,604	0.8%
	2018 Bales	14,636	24,730	9,284	15,758	9,964	74,371	0.6%
	Change	(70.8%)	(13.1%)	(20.5%)	(57.3%)	(35.4%)	(47.8%)	
Tennessee (8 BEAs)	2008 Bales	372,130	1,100,480	684,145	183,759	440,822	2,781,336	16.6%
	2018 Bales	142,653	519,790	236,361	100,092	300,755	1,299,651	10.3%
	Change	(61.7%)	(52.8%)	(65.5%)	(45.5%)	(31.8%)	(53.3%)	
Texas (16 BEAs)	2008 Bales	736,312	2,301,198	1,018,671	777,847	1,254,498	6,088,525	36.3%
	2018 Bales	314,457	2,217,224	697,499	551,159	943,382	4,723,722	37.5%
	Change	(57.3%)	(3.6%)	(31.5%)	(29.1%)	(24.8%)	(22.4%)	
Virginia (9 BEAs)	2008 Bales	95,320	50,645	17,404	28,508	31,519	223,396	1.3%
	2018 Bales	32,954	64,519	39,838	19,834	39,222	196,367	1.6%
	Change	(65.4%)	27.4%	128.9%	(30.4%)	24.4%	(12.1%)	
Total	2008 Bales	3,591,355	5,307,847	2,846,479	1,865,947	3,175,663	16,787,290	
	2018 Bales	1,435,286	5,233,013	2,109,339	1,249,805	2,542,668	12,570,113	
	Change	(60.0%)	(1.4%)	(25.9%)	(33.0%)	(19.9%)	(25.1%)	

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.
Note: For BEAs associated with a state, see Exhibit 16: Appendix C, to cross reference a state, county and BEA number.

Domestic Flows between Regions and International Destinations

Export shipments to international destinations are listed in **Exhibit 40**. In this table, shipment amounts are shown for the top 14 receiving countries and one row for a summary of the remaining countries. Total shipments in 2008 to countries receiving shipments from the cotton producing regions was 13,279,995 bales, and Transearch forecasts 2018 shipments to the receiving countries to be 11,199,425. The forecast represents a 15.7 percent decline from 2008 to 2018. These top 14 countries consume just over 91 percent of all U.S. cotton exports.

In 2008, the top five countries received 67.9 percent of the total bales shipped, while the top ten countries received over 84.6 percent. For 2018, the accumulated share for the top five countries stays relatively constant at 67.8 percent, while the share for the top ten receiving countries drops slightly to 83.2 percent. The 2008 volume for the top ten receiving countries was 11,362,260 bales while the 2018 receiving volume for the top ten is forecast to be 9,414,227 bales. This represents a decline of 1,943,393 bales or 15.1 percent and is 85.8 percent of the total export decrease.

China is the country that receives the most export cotton from the U.S. In 2008, China received 4,022,612 bales or 29.9 percent share of the total U.S. exports. In 2018, China is forecast to increase the volume it imports from the U.S. to 4,336,089 bales which represents a 7.8 percent gain. This will increase China's share to 38.3 percent.

From the list of 14 countries shown in the **Exhibit 39**, four other countries show positive growth for cotton imports from the U.S. for 2008 to 2018:

- Vietnam increases its volume by approximately 24,000 bales;
- Pakistan increases its volume by approximately 44,000 bales;
- Bangladesh increases its volume by approximately 50,000; and
- India increases its volume by approximately 88,000 bales.

The nine remaining countries shown in the **Exhibit 40** all experience decreases, with Turkey, Indonesia and Mexico having the largest reductions:

- Turkey declines by approximately 607,000 bales;
- Indonesia declines by approximately 415,000 bales;
- Mexico declines by approximately 402,000 bales;
- Thailand declines by approximately 338,000 bales;
- Taiwan declines by approximately 200,00 bales;
- Japan declines by approximately 228,000 bales;
- South Korea declines by approximately 113,000 bales;
- Columbia declines by approximately 64,000 bales; and
- Peru declines by approximately 82,000 bales.

The Southwest region exported the largest cotton share of total exports in 2008 accounting for 41.5 percent of shipments. The Mid-South shipped the second largest share at 27.7 percent, followed by the Southeast at 20 percent and the West at 10.2 percent.

Exhibit 40: Cotton Flows from Producing Regions to Top 12 International Destinations

		Cotton Producing Regions						Share	
Destination	Data	West	Southwest	Mid-South	Southeast	Other	Total	Area's	Cumulative
China	2008 Bales	543,659	1,945,001	1,069,378	433,676	30,899	4,022,612	30.3%	30.3%
	2018 Bales	650,657	1,982,955	1,147,041	526,509	28,926	4,336,089	38.7%	38.7%
	Change	19.7%	2.0%	7.3%	21.4%	(6.4%)	7.8%		
Turkey	2008 Bales	49,375	778,100	389,777	622,310	416	1,839,978	13.9%	44.1%
	2018 Bales	32,493	550,956	226,827	421,663	305	1,232,244	11.0%	49.7%
	Change	(34.2%)	(29.2%)	(41.8%)	(32.2%)	(26.8%)	(33.0%)		
Indonesia	2008 Bales	155,859	526,260	220,857	292,287	331	1,195,595	9.0%	53.1%
	2018 Bales	109,580	316,585	138,034	216,088	242	780,529	7.0%	56.7%
	Change	(29.7%)	(39.8%)	(37.5%)	(26.1%)	(27.1%)	(34.7%)		
Mexico	2008 Bales	50,534	566,705	468,447	25,815	140	1,111,641	8.4%	61.5%
	2018 Bales	32,249	361,655	298,959	16,513	89	709,465	6.3%	63.0%
	Change	(36.2%)	(36.2%)	(36.2%)	(36.0%)	(36.2%)	(36.2%)		
Thailand	2008 Bales	80,616	266,366	386,593	221,684	476	955,734	7.2%	68.7%
	2018 Bales	55,784	158,029	244,708	158,561	318	617,401	5.5%	68.5%
	Change	(30.8%)	(40.7%)	(36.7%)	(28.5%)	(33.2%)	(35.4%)		
Vietnam	2008 Bales	21,967	229,304	260,500	125,175	37	636,983	4.8%	73.5%
	2018 Bales	30,638	220,732	260,062	149,404	35	660,871	5.9%	74.4%
	Change	39.5%	(3.7%)	(0.2%)	19.4%	(5.6%)	3.8%		
Taiwan	2008 Bales	22,857	138,751	200,280	141,187	371	503,446	3.8%	77.3%
	2018 Bales	15,846	75,422	115,939	95,578	253	303,038	2.7%	77.1%
	Change	(30.7%)	(45.6%)	(42.1%)	(32.3%)	(31.7%)	(39.8%)		
Japan	2008 Bales	40,649	62,135	78,639	219,217	40,352	440,992	3.3%	80.6%
	2018 Bales	16,284	24,762	33,702	110,473	27,882	213,103	1.9%	79.0%
	Change	(59.9%)	(60.1%)	(57.1%)	(49.6%)	(30.9%)	(51.7%)		
Pakistan	2008 Bales	72,532	145,373	72,622	41,617	64	332,208	2.5%	83.1%
	2018 Bales	81,680	160,045	75,165	59,397	66	376,352	3.4%	82.4%
	Change	12.6%	10.1%	3.5%	42.7%	2.7%	13.3%		
South Korea	2008 Bales	56,121	165,945	15,197	34,625	36	271,925	2.0%	85.2%
	2018 Bales	35,478	91,628	8,841	23,162	24	159,133	1.4%	83.8%
	Change	(36.8%)	(44.8%)	(41.8%)	(33.1%)	(32.7%)	(41.5%)		
Bangladesh	2028 Bales	25,206	59,180	46,706	122,082	139	253,313	1.9%	87.1%
	2038 Bales	28,675	63,672	48,181	162,596	211	303,336	2.7%	86.5%
	Change	13.8%	7.6%	3.2%	33.2%	51.8%	19.7%		
Columbia	2048 Bales	9,665	163,698	46,768	21,759	0	241,890	1.8%	88.9%
	2058 Bales	7,217	123,202	30,968	16,720	0	178,106	1.6%	88.1%
	Change	(25.3%)	(24.7%)	(33.8%)	(23.2%)	0.0%	(26.4%)		
Peru	2068 Bales	35,602	85,469	48,411	66,257	12	235,750	1.8%	90.7%
	2078 Bales	22,357	54,741	29,269	47,691	10	154,067	1.4%	89.5%
	Change	(37.2%)	(36.0%)	(39.5%)	(28.0%)	(19.8%)	(34.6%)		
India	2088 Bales	87,109	29,171	44,098	43,685	0	204,064	1.5%	92.2%
	2098 Bales	120,533	40,375	63,499	68,063	0	292,470	2.6%	92.1%
	Change	38.4%	38.4%	44.0%	55.8%	0.0%	43.3%		
Remaining Countries	2008 Bales	102,468	353,644	324,474	243,764	9,514	1,033,864	7.8%	100.0%
	2018 Bales	77,380	313,291	276,281	211,118	5,153	883,223	7.9%	100.0%
	Change	(24.5%)	(11.4%)	(14.9%)	(13.4%)	(45.8%)	(14.6%)		

Total Int'l Bales	2008 Bales	1,354,218	5,515,103	3,672,746	2,655,140	82,787	13,279,995
	2018 Bales	1,316,849	4,538,049	2,997,476	2,283,538	63,512	11,199,425
	Change	(2.8%)	(17.7%)	(18.4%)	(14.0%)	(23.3%)	(15.7%)
2008 Regional Share		10.2%	41.5%	27.7%	20.0%	0.6%	100.0%

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

All cotton producing regions are forecasted to experience a decline in exports from 2008 to 2018. In **Exhibit 41**, port locations are listed across the top of the table and the destination markets are listed in the table's left-hand column. Port share and accumulated share are listed at the bottom of the table and destination market share and accumulated share is listed in the right columns.

Port locations at Los Angeles and Savannah dominate cotton export activity with a combined total of 73.2 percent of the export traffic. Los Angeles has 59.3 percent in 2008 and its share grows to 63.2 percent in 2018.

Los Angeles handled 4,390,638 bales of cotton bound for Asia in 2008, 2,291,252 bales bound for Southeast Asia and 345,523 bales bound for the Indian Sub Continent. Totaling these top three trade routes equals 7,027,413, which was 57.9 percent of all of the cotton bales exported by the U.S.

Looking at similar destinations Savannah handled 506,334 bales of cotton bound for Asia in 2008, 356,493 bales bound for Southeast Asia and 140,557 bound for the Indian Sub Continent for a total of 1,003,384 bales. Los Angeles and Savannah combined equal 8,030,797 bales or 66.2 percent of the U.S. total exports.

Savannah largest destination for cotton exports was 545,033 bales bound to the Middle East in 2008. The other major ports handling cotton exports in 2008 to the Middle East were Houston with 845,663 bales, Charleston with 141,359 bales, and New Orleans with 193,718 bales. These four ports combined handled 1,725,773 bales to the Middle East or 14.2 percent of the U.S. total exports.

Exhibit 42 shows major destination countries and port of export out of the U.S. Los Angeles handled 3,464,945 bales to China, 958,129 bales to Indonesian, 792,317 bales to Thailand, 493,291 bales to Vietnam, 369,073 bales to Taiwan, and 203,271 bales to Japan.

Other major port/destination combinations include Houston which handled 835,691 bales to Turkey and Charleston at 138,650 bales to Turkey. Oakland handled 155,619 bales to China and New Orleans at 193,718 bales to Turkey. These four ports are forecast to experience declining volumes from 2008 to 2018.

For the top ten destination countries, five are forecast to consume more U.S. cotton in the future: China at 7.8 percent, Vietnam at 3.8 percent, Pakistan at 13.3 percent, Bangladesh at 19.7 percent, and India at 43.3 percent. The countries in the Indian Sub Continent are forecast to grow, and the countries in Asia, except China, are forecast to decline.

Exhibit 41: Export Cotton Flows from U.S. Ports to Foreign Continental Markets

Destination	Year	Data	Los Angeles	Savannah	Houston	Charleston	Oakland	New Orleans	Norfolk	Gulfport	Freeport	Other Ports	Grand Total	Area	Cumulative
Asia	2008	Bales	4,390,638	506,334	75,287	63,107	217,207	2,238	104,046			21,357	5,380,216	44.4%	44.4%
	2018	Bales	4,412,408	450,457	80,391	50,133	207,356	4,500	76,518			9,269	5,291,032	50.6%	50.6%
		Change	0.5%	(11.0%)	6.8%	(20.6%)	(4.5%)	101.0%	(26.5%)	0.0%	0.0%	(56.6%)	(1.7%)		
Southeast Asia	2008	Bales	2,291,252	356,493	28,954	36,138	75,035	266	55,481			4,277	2,847,897	23.5%	67.9%
	2018	Bales	1,683,973	282,911	20,498	31,133	49,805	209	38,270			3,531	2,110,330	20.2%	70.7%
		Change	(26.5%)	(20.6%)	(29.2%)	(13.8%)	(33.6%)	(21.5%)	(31.0%)	0.0%	0.0%	(17.4%)	(25.9%)		
Middle East	2008	Bales	51,123	545,033	845,663	141,359	506	193,718	47,602			41,442	1,866,446	15.4%	83.3%
	2018	Bales	29,431	376,558	558,598	99,940	282	127,478	30,243			27,622	1,250,153	11.9%	82.7%
		Change	(42.4%)	(30.9%)	(33.9%)	(29.3%)	(44.3%)	(34.2%)	(36.5%)	0.0%	0.0%	(33.3%)	(33.0%)		
Indian Sub Continent	2008	Bales	345,523	140,557	57,642	111,222	97,151	24,791	14,286			2,394	793,567	6.5%	89.8%
	2018	Bales	423,425	178,523	67,326	133,334	123,860	30,843	16,891			2,602	976,804	9.3%	92.0%
		Change	22.5%	27.0%	16.8%	19.9%	27.5%	24.4%	18.2%	0.0%	0.0%	8.7%	23.1%		
South America	2008	Bales	63,075	64,013	332,086	38,958	11,317	80,381	9,341		91,733	2,173	693,078	5.7%	95.5%
	2018	Bales	35,793	46,833	234,900	27,507	6,865	50,200	6,351		63,447	1,412	473,309	4.5%	96.5%
		Change	(43.3%)	(26.8%)	(29.3%)	(29.4%)	(39.3%)	(37.5%)	(32.0%)	0.0%	(30.8%)	(35.0%)	(31.7%)		
Central America	2008	Bales	22,778	33,054	49,456	37,165	553	46,449	1,806	126,551	4,293	37,744	359,849	3.0%	98.5%
	2018	Bales	15,655	25,459	36,726	31,484	366	34,851	1,254	92,350	3,113	27,373	268,631	2.6%	99.1%
		Change	(31.3%)	(23.0%)	(25.7%)	(15.3%)	(33.8%)	(25.0%)	(30.5%)	(27.0%)	(27.5%)	(27.5%)	(25.3%)		
Europe	2028	Bales	21,019	14,938	72,584	2,534	9,226	5,537	8,603			700	135,141	1.1%	99.6%
	2038	Bales	9,476	5,907	30,472	1,262	4,178	2,123	3,112			355	56,885	0.5%	99.6%
		Change	(54.9%)	(60.5%)	(58.0%)	(50.2%)	(54.7%)	(61.7%)	(63.8%)	0.0%	0.0%	(49.3%)	(57.9%)		
Africa	2048	Bales	8,605	15,138	2,375	1,025	6,600		1,017			0	34,759	0.3%	99.9%
	2058	Bales	5,297	15,679	2,551	1,096	3,477		1,097			0	29,197	0.3%	99.9%
		Change	(38.4%)	3.6%	7.4%	7.0%	(47.3%)	0.0%	7.9%	0.0%	0.0%	0.0%	(16.0%)		
Caribbean	2068	Bales	610	494	1,499			3,749				3,290	9,643	0.1%	100.0%
	2078	Bales	421	395	1,151			2,960				2,328	7,255	0.1%	100.0%
		Change	(31.0%)	(20.2%)	(23.2%)	0.0%	0.0%	(21.1%)	0.0%	0.0%	0.0%	(29.2%)	(24.8%)		
North America (No Mex or Can)	2088	Bales										0	0	0.0%	100.0%
	2098	Bales										0	0	0.0%	100.0%
		Change	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
Pacific	2108	Bales	6	1,575		744				147		462	2,934	0.0%	100.0%
	2118	Bales	4	920		460				118		252	1,754	0.0%	100.0%
		Change	(35.6%)	(41.6%)	0.0%	(38.1%)	0.0%	0.0%	0.0%	(19.8%)	0.0%	(45.4%)	(40.2%)		
Total Bales	2008	Bales	7,194,628	1,677,630	1,465,545	432,253	417,597	357,130	242,181	126,697	96,026	113,841	12,123,529	100.0%	100.0%
	2018	Bales	6,615,883	1,383,642	1,032,613	376,350	396,189	253,163	173,737	92,468	66,560	74,744	10,465,349	100.0%	100.0%
		Change	(8.0%)	(17.5%)	(29.5%)	(12.9%)	(5.1%)	(29.1%)	(28.3%)	(27.0%)	(30.7%)	(34.3%)	(13.7%)		
Port Share	2008	Share	59.3%	13.8%	12.1%	3.6%	3.4%	2.9%	2.0%	1.0%	0.8%	0.9%	100.0%		
		Cumulative	59.3%	73.2%	85.3%	88.8%	92.3%	95.2%	97.2%	98.3%	99.1%	100.0%	100.0%		
	2018	Share	63.2%	13.2%	9.9%	3.6%	3.8%	2.4%	1.7%	0.9%	0.6%	0.7%	100.0%		
		Cumulative	63.2%	76.4%	86.3%	89.9%	93.7%	96.1%	97.8%	98.6%	99.3%	100.0%	100.0%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales. There was no ocean port traffic to Mexico or Canada.

Exhibit 42: Export Cotton Flows from U.S. Ports to Foreign Countries

Destination	Year	Data	Los Angeles	Savannah	Houston	Charleston	Oakland	New Orleans	Norfolk	Gulfport	Freeport	Other Ports	Grand Total	Area	Cumulative
China	2008	Bales	3,464,945	289,955	59,192	29,185	155,619		22,054			1,663	4,022,612	33.2%	33.2%
	2018	Bales	3,736,800	309,742	66,373	31,307	166,348		23,789			1,729	4,336,089	41.4%	41.4%
		Change	7.8%	6.8%	12.1%	7.3%	6.9%	0.0%	7.9%	0.0%	0.0%	4.0%	7.8%		
Turkey	2008	Bales	37,413	545,033	835,691	138,650	429	193,718	47,602			41,442	1,839,978	15.2%	48.4%
	2018	Bales	20,345	376,558	551,610	98,158	229	127,478	30,243			27,622	1,232,244	11.8%	53.2%
		Change	(45.6%)	(30.9%)	(34.0%)	(29.2%)	(47%)	(34.2%)	(36.5%)	0.0%	0.0%	(33.3%)	(33.0%)		
Indonesia	2008	Bales	958,129	136,076	11,315	13,120	49,500		27,414			42	1,195,595	9.9%	58.2%
	2018	Bales	621,936	91,797	7,289	9,022	32,502		17,951			32	780,529	7.5%	60.7%
		Change	(35.1%)	(32.5%)	(35.6%)	(31.2%)	(34.3%)	0.0%	(34.5%)	0.0%	0.0%	(22.9%)	(34.7%)		
Thailand	2008	Bales	792,317	97,860	12,600	7,899	20,507	266	22,780			1,506	955,734	7.9%	66.1%
	2018	Bales	512,339	62,206	8,036	5,677	13,118	209	14,841			975	617,401	5.9%	66.6%
		Change	(35.3%)	(36.4%)	(36.2%)	(28.1%)	(36.0%)	(21.5%)	(34.9%)	0.0%	0.0%	(35.2%)	(35.4%)		
Vietnam	2008	Bales	493,291	114,187	5,040	15,119	2,618		3,998			2,730	636,983	5.3%	71.4%
	2018	Bales	508,367	121,431	5,174	16,435	2,683		4,258			2,524	660,871	6.3%	72.9%
		Change	3.1%	6.3%	2.7%	8.7%	2.5%	0.0%	6.5%	0.0%	0.0%	(7.6%)	3.8%		
Taiwan	2008	Bales	369,073	80,890	10,832	9,574	11,887		17,407			3,783	503,446	4.2%	75.5%
	2018	Bales	219,813	50,815	6,345	6,400	7,024		10,916			1,725	303,038	2.9%	75.8%
		Change	(40.4%)	(37.2%)	(41.4%)	(33.1%)	(40.9%)	0.0%	(37.3%)	0.0%	0.0%	(54.4%)	(39.8%)		
Pakistan	2008	Bales	129,173	28,539	52,908	64,784	35,613	19,169	365			1,657	332,208	2.7%	78.2%
	2018	Bales	141,715	35,640	60,863	73,180	39,897	22,816	400			1,841	376,352	3.6%	79.4%
		Change	9.7%	24.9%	15.0%	13.0%	12.0%	19.0%	9.5%	0.0%	0.0%	11.1%	13.3%		
Japan	2008	Bales	203,271	104,755	1,145	23,880	32,133		60,877			14,931	440,992	3.6%	81.9%
	2018	Bales	91,145	51,949	497	11,928	14,913		37,289			5,381	213,103	2.0%	81.4%
		Change	(55.2%)	(50.4%)	(56.6%)	(50.0%)	(53.6%)	0.0%	(38.7%)	0.0%	0.0%	(64.0%)	(51.7%)		
Bangladesh	2008	Bales	98,124	96,870	1,262	31,791	9,105	1,503	13,921			737	253,313	2.1%	84.0%
	2018	Bales	110,166	121,556	1,413	40,315	10,560	2,074	16,492			760	303,336	2.9%	84.3%
		Change	12.3%	25.5%	11.9%	26.8%	16.0%	38.0%	18.5%	0.0%	0.0%	3.2%	19.7%		
India	2008	Bales	115,162	15,148	2,554	14,647	52,433	4,120				0	204,064	1.7%	85.7%
	2018	Bales	168,256	21,326	3,692	19,839	73,403	5,954				0	292,470	2.8%	87.1%
		Change	46.1%	40.8%	44.6%	35.4%	40.0%	44.5%	0.0%	0.0%	0.0%	0.0%	43.3%		
Remaining Countries	2008	Bales	533,730	168,318	473,008	83,605	47,751	138,355	25,764	126,697	96,026	45,351	1,738,604	14.3%	100.0%
	2018	Bales	485,000	140,620	321,323	64,090	35,511	94,633	17,558	92,468	66,560	32,155	1,349,919	12.9%	100.0%
		Change	(9.1%)	(16.5%)	(32.1%)	(23.3%)	(25.6%)	(31.6%)	(31.8%)	(27.0%)	(30.7%)	(29.1%)	(22.4%)		
Total Bales	2008	Bales	7,194,628	1,677,630	1,465,545	432,253	417,597	357,130	242,181	126,697	96,026	113,841	12,123,529	100.0%	100.0%
	2018	Bales	6,615,883	1,383,642	1,032,613	376,350	396,189	253,163	173,737	92,468	66,560	74,744	10,465,350	100.0%	100.0%
		Change	(8.0%)	(17.5%)	(29.5%)	(12.9%)	(5.1%)	(29.1%)	(28.3%)	(27.0%)	(30.7%)	(34.3%)	(13.7%)		
Port Share	2008	Share	59.3%	13.8%	12.1%	3.6%	3.4%	2.9%	2.0%	1.0%	0.8%	0.9%	100.0%		
		Cumulative	59.3%	73.2%	85.3%	88.8%	92.3%	95.2%	97.2%	98.3%	99.1%	100.0%	100.0%		
	2018	Share	63.2%	13.2%	9.9%	3.6%	3.8%	2.4%	1.7%	0.9%	0.6%	0.7%	100.0%		
		Cumulative	63.2%	76.4%	86.3%	89.9%	93.7%	96.1%	97.8%	98.6%	99.3%	100.0%	100.0%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Shipments To or From "Other" Locations

In the Transearch dataset, small quantities of cotton were shown to be shipped from outside the four standard cotton production regions. However, bales shipped out of these "Other" states are not necessarily grown or ginned within these states. Rather, these records reflect trans-shipments. For example, bales produced in Tennessee may be transported to Chicago's rail terminals in trucks seeking backhauls out of the Mid-South. The bales are trans-loaded in Chicago onto intermodal trains for export from West Coast or East Coast ports. These appear as two separate shipments, with the second one originating in Chicago, but they are actually a single move with a trans-load in the middle. Due to the way the datasets are structured, Transearch is unable to connect the different legs into a contiguous shipment record. The same data anomaly can occur at a port, where trucks could bring bales for loading onto a vessel for export. Bales appear to originate at that port rather than at a cotton production region because they were trans-loaded at the port. This same situation can also occur at border crossings into Canada or Mexico where customs processing for the arriving and departing legs makes a single move appear to be two.

Chicago and Louisville are two of the larger truck/rail trans-shipping points. According to Global Insight, Chicago sent 24,000 bales to the West Coast for Asian exports. Louisville sent 39,000 bales to Norfolk for shipment to Japan via the Panama Canal. Denver appears to be a backhaul consolidation point for trans-shipping cotton from North Texas and sent 13,000 bales to the West Coast. These three locations are not production areas and represent 85 percent of the "Other" category, but less than six tenths of one percent of total bale exports. Grand Forks, ND, recorded 5,400 bales most likely for crossing into Canada and Salisbury, MD, recorded 4,400 bales that could represent customs way-bills. Grand Forks and Salisbury represent around 10 percent of the "Other" category but less than seven hundredths of one percent of total bale exports. Volumes from these locations were deemed to not have a material impact on the least cost modeling.

Export Flows from Producing Regions to Coastal Regions

The utilization of truck or rail to transport bales for export from cotton producing regions to coastal regions or land borders is shown in **Exhibit 43**. Port regions are classified as East Coast, Gulf Coast and West Coast. Land border crossings into Mexico and Canada also are included in the table. Over 7.3 million bales reached port by rail and almost 6.0 million bales reached port by truck resulting in U.S. exports of 13.3 plus million bales. The West Coast received over 57 percent of all bales transported, the East Coast 18.3 percent, the Gulf 15.7 percent and 8.7 percent crossed the land borders with Mexico and Canada. Mexico received over 96 percent of the bale traffic that crossed the land borders. The Southwest was by far the largest exporting region with 41.5 percent of the total, followed by the Mid-South at 27.7 percent and the Southeast at 20 percent.

In 2008, approximately 44 percent of the export bales were shipped by rail to the West Coast. This reflects the large number of bales transported by intermodal which is more economical than truck for the long-haul moves from the Southeast, Mid-South and Southwest.

Exhibit 43: Modal Flows from Producing Regions to Coastal Regions

			Cotton Producing Regions						
Port Region	Year	Mode	West	Southwest	Mid-South	Southeast	Other	Total	Share
East Coast	2008	Truck	45,858	477,519	102,345	976,472	1,121	1,603,315	12.1%
		Rail	249,618		363,406	170,506	39,799	823,329	6.2%
		Regional Total	295,476	477,519	465,750	1,146,978	40,920	2,426,643	18.3%
Gulf Coast	2008	Truck	71,326	829,405	493,913	332,261	271	1,727,177	13.0%
		Rail	41,043	4,367	278,047	36,752	62	360,271	2.7%
		Regional Total	112,369	833,772	771,960	369,014	333	2,087,448	15.7%
West Coast	2008	Truck	890,483	322,624	252,703	278,680	2,058	1,746,548	13.2%
		Rail		3,307,517	1,708,572	820,881	30,072	5,867,042	44.2%
		Regional Total	890,483	3,630,141	1,961,275	1,099,561	32,130	7,613,589	57.3%
Land Border	2008	Truck	52,657	573,670	219,500	27,798	4,881	878,507	6.6%
		Rail	3,232		254,261	11,790	4,524	273,807	2.1%
		Regional Total	55,889	573,670	473,761	39,588	9,405	1,152,314	8.7%
Total for	2008	Truck	1,060,324	2,203,219	1,068,461	1,615,211	8,331	5,955,546	44.8%
All Regions		Rail	293,894	3,311,884	2,604,285	1,039,929	74,456	7,324,448	55.2%
Truck + Rail		Combined Total	1,354,218	5,515,103	3,672,746	2,655,140	82,787	13,279,995	
		Producing Region's Share	10.2%	41.5%	27.7%	20.0%	0.6%		

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Modal Forecast for Exports from Producing Regions to Coastal Regions

The Transearch forecast for 2018 over 2008 for truck and rail transport from cotton producing regions to coastal regions is shown in **Exhibit 44** and to the top ports in **Exhibit 45**. Transearch forecasts a general decline in exports for all regions to all destinations. **Exhibit 44** indicates that for the receiving ocean ports, the Gulf Coast is forecast to decline by 29.3 percent, the East Coast to decline by 18.5 percent and the West Coast to decline by 7.9 percent. Cross border shipments to Mexico are forecast to decline by 36.5 percent.

For the producing regions, the forecast for the Mid-South shows the largest decline at 18.4 percent with most of that occurring for transport to the Gulf Coast ports. The Southwest shows a 17.7 percent decline with 2.8 percent fewer bales being shipped to the West Coast. For the West Coast, only the West region generates significant truck volume and there are few rail shipments.

Rail moves a large number of containers to the ports in Los Angeles. The total number of bales moved by rail exceeds truck volumes. Rail transported 7,324,448 bales to the ports in 2008 and is forecast to move 6,486,028 bales in 2018, a 11.4 percent decline. Truck moved 5,955,546 bales to ports in 2008 and is forecast to move 4,713,397 bales in 2018, a 20.9 percent decline. Rail's projected decline for the Los Angeles ports for 2018 is forecast to be 8.0 percent. Even with a decline, rail will remain the main mode for exports to Asia through the Los Angeles ports. The decline for 2018 in most of the other coastal regions and ports is forecast to be double digit.

Exhibit 44: Modal Forecast from Producing Regions to Coastal Regions

			Cotton Producing Regions						
Port Region	Year	Mode	West	Southwest	Mid-South	Southeast	Other	Total	Share
East Coast	2008	Truck	45,858	477,519	102,345	976,472	1,121	1,603,315	66.1%
	2018	Truck	37,594	391,321	84,509	804,777	904	1,319,106	66.7%
		Change	(18.0%)	(18.1%)	(17.4%)	(17.6%)	(19.3%)	(17.7%)	
	2008	Rail	249,618		363,406	170,506	39,799	823,329	33.9%
	2018	Rail	193,090		279,718	158,568	27,562	658,939	33.3%
		Change	(22.6%)		(23.0%)	(7.0%)	(30.7%)	(20.0%)	
	2008	Combined	295,476	477,519	465,750	1,146,978	40,920	2,426,643	
	2018	Combined	230,685	391,321	364,227	963,346	28,467	1,978,046	
		Change	(21.9%)	(18.1%)	(21.8%)	(16.0%)	(30.4%)	(18.5%)	
Gulf Coast	2008	Truck	71,326	829,405	493,913	332,261	271	1,727,177	82.7%
	2018	Truck	50,414	586,109	350,139	235,728	191	1,222,582	82.8%
		Change	(29.3%)	(29.3%)	(29.1%)	(29.1%)	(29.5%)	(29.2%)	
	2008	Rail	41,043	4,367	278,047	36,752	62	360,271	17.3%
	2018	Rail	29,274	2,694	181,287	40,946	62	254,263	17.2%
		Change	(28.7%)	(38.3%)	(34.8%)	11.4%	1.2%	(29.4%)	
	2008	Combined	112,369	833,772	771,960	369,014	333	2,087,448	
	2018	Combined	79,689	588,803	531,426	276,674	254	1,476,845	
		Change	(29.1%)	(29.4%)	(31.2%)	(25.0%)	(23.9%)	(29.3%)	
West Coast	2008	Truck	890,483	322,624	252,703	278,680	2,058	1,746,548	22.9%
	2018	Truck	820,923	298,554	234,247	258,025	1,891	1,613,640	23.0%
		Change	(7.8%)	(7.5%)	(7.3%)	(7.4%)	(8.1%)	(7.6%)	
	2008	Rail		3,307,517	1,708,572	820,881	30,072	5,867,042	77.1%
	2018	Rail	150,056	2,893,269	1,566,050	762,110	28,029	5,399,515	77.0%
		Change	100.0%	(12.5%)	(8.3%)	(7.2%)	(6.8%)	(8.0%)	
	2008	Combined	890,483	3,630,141	1,961,275	1,099,561	32,130	7,613,589	
	2018	Combined	970,978	3,191,824	1,800,297	1,020,136	29,920	7,013,155	
		Change	9.0%	(12.1%)	(8.2%)	(7.2%)	(6.9%)	(7.9%)	
Land Ports; Border Crossings to Mexico & Canada	2008	Truck	52,657	573,670	219,500	27,798	4,881	878,507	76.2%
	2018	Truck	33,604	366,101	139,918	15,926	2,518	558,068	76.3%
		Change	(36.2%)	(36.2%)	(36.3%)	(42.7%)	(48.4%)	(36.5%)	
	2008	Rail	3,232		254,261	11,790	4,524	273,807	23.8%
	2018	Rail	1,894		161,608	7,456	2,354	173,311	23.7%
		Change	(41.4%)		(36.4%)	(36.8%)	(48.0%)	(36.7%)	
	2008	Combined	55,889	573,670	473,761	39,588	9,405	1,152,314	
	2018	Combined	35,498	366,101	301,526	23,383	4,872	731,379	
		Change	(36.5%)	(36.2%)	(36.4%)	(40.9%)	(48.2%)	(36.5%)	
Total	2008	Truck	1,060,324	2,203,219	1,068,461	1,615,211	8,331	5,955,546	44.8%
	2018	Truck	942,535	1,642,085	808,813	1,314,458	5,505	4,713,397	42.1%
		Change	(11.1%)	(25.5%)	(24.3%)	(18.6%)	(33.9%)	(20.9%)	
	2008	Rail	293,894	3,311,884	2,604,285	1,039,929	74,456	7,324,448	55.2%
	2018	Rail	374,314	2,895,964	2,188,663	969,080	58,007	6,486,028	57.9%
		Change	27.4%	(12.6%)	(16.0%)	(6.8%)	(22.1%)	(11.4%)	
	2008	Combined	1,354,218	5,515,103	3,672,746	2,655,140	82,787	13,279,995	
	2018	Combined	1,316,849	4,538,049	2,997,476	2,283,538	63,512	11,199,425	
		Change	(2.8%)	(17.7%)	(18.4%)	(14.0%)	(23.3%)	(15.7%)	

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Exhibit 45 and **Exhibit 46** show bale flows from the cotton producing regions and to the main ports, respectively. Due to the long length of hauls to the western ports, rail shipments are approximately 79 percent of the total to Los Angeles and over 45 percent to Oakland. For the eastern and gulf ports, where the length of haul is usually only several hundred miles, truck service is faster and dominant with over 65 percent of the traffic to East Coast ports and 82 percent of the traffic to Gulf Coast ports.

Exhibit 45: Export Cotton Flows from Producing Regions to Ports

			Cotton Producing Regions						
Port City	Year	Mode	West	Southwest	Mid-South	Southeast	Other	Total	Share
Los Angeles	2008	Truck	824,761	263,175	202,970	230,335	2,058	1,523,299	21.2%
	2018	Truck	757,914	241,544	186,562	211,673	1,891	1,399,583	21.2%
		Change	(8.1%)	(8.2%)	(8.1%)	(8.1%)	(8.1%)	(8.1%)	
	2008	Rail		3,218,292	1,642,720	790,152	20,166	5,671,329	78.8%
	2018	Rail	145,999	2,815,110	1,508,196	728,463	18,531	5,216,300	78.8%
		Change	100.0%	(12.5%)	(8.2%)	(7.8%)	(8.1%)	(8.0%)	
	2008	Combined	824,761	3,481,467	1,845,689	1,020,487	22,224	7,194,628	
	2018	Combined	903,913	3,056,654	1,694,758	940,136	20,422	6,615,883	
		Change	9.6%	(12.2%)	(8.2%)	(7.9%)	(8.1%)	(8.0%)	
Savannah	2008	Truck	31,914	342,841	67,469	737,047	753	1,180,025	70.3%
	2018	Truck	26,433	283,961	55,907	610,465	624	977,391	70.6%
		Change	(17.2%)	(17.2%)	(17.1%)	(17.2%)	(17.2%)	(17.2%)	
	2008	Rail	114,533		284,726	98,346		497,605	29.7%
	2018	Rail	88,672		218,521	99,058		406,252	29.4%
		Change	(22.6%)		(23.3%)	0.7%		(18.4%)	
	2008	Combined	146,447	342,841	352,195	835,394	753	1,677,630	
	2018	Combined	115,105	283,961	274,429	709,524	624	1,383,642	
		Change	(21.4%)	(17.2%)	(22.1%)	(15.1%)	(17.2%)	(17.5%)	
Houston	2008	Truck	53,435	646,140	290,093	194,486	222	1,184,377	80.8%
	2018	Truck	37,590	454,544	204,073	136,816	156	833,180	80.7%
		Change	(29.7%)	(29.7%)	(29.7%)	(29.7%)	(29.7%)	(29.7%)	
	2008	Rail	24,168		257,001			281,169	19.2%
	2018	Rail	16,611		169,200	13,623		199,433	19.3%
		Change	(31.3%)		(34.2%)	0.0%		(29.1%)	
	2008	Combined	77,603	646,140	547,094	194,486	222	1,465,545	
	2018	Combined	54,201	454,544	373,273	150,439	156	1,032,613	
		Change	(30.2%)	(29.7%)	(31.8%)	(22.6%)	(29.7%)	(29.5%)	
Charleston	2008	Truck	8,869	85,064	26,110	172,159	146	292,348	67.6%
	2018	Truck	7,181	70,407	89,147	58,848	125	225,707	64.2%
		Change	(19.0%)	(17.2%)	241.4%	(65.8%)	(14.3%)	(22.8%)	
	2008	Rail	41,397		70,021	28,488		139,905	32.4%
	2018	Rail	41,715		55,823	28,396		125,933	35.8%
		Change	0.8%		(20.3%)	(0.3%)		(10.0%)	
	2008	Combined	50,265	85,064	96,130	200,646	146	432,253	
	2018	Combined	48,896	70,407	144,969	87,243	125	351,640	
		Change	(2.7%)	(17.2%)	50.8%	(56.5%)	(14.3%)	(18.6%)	
Oakland	2008	Truck	65,572	59,449	49,733	48,345		223,099	53.4%
	2018	Truck	62,869	57,011	47,685	46,352		213,917	54.0%
		Change	(4.1%)	(4.1%)	(4.1%)	(4.1%)		(4.1%)	
	2008	Rail		88,482	65,381	30,729	9,906	194,498	46.6%
	2018	Rail	4,018	77,631	57,477	33,647	9,498	182,272	46.0%
		Change	0.0%	(12.3%)	(12.1%)	9.5%	(4.1%)	(6.3%)	
	2008	Combined	65,572	147,931	115,114	79,074	9,906	417,597	
	2018	Combined	66,887	134,642	105,163	80,000	9,498	396,189	
		Change	2.0%	(9.0%)	(8.6%)	1.2%	(4.1%)	(5.1%)	

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Exhibit 46: Export Cotton Flows from Producing Regions to Ports (continued)

			Cotton Producing Regions						
Port City	Year	Mode	West	Southwest	Mid-South	Southeast		Total	Share
New Orleans	2008	Truck	10,114	99,167	125,531	82,886	50	317,747	89.0%
	2018	Truck	7,181	70,407	89,147	58,848	35	225,617	89.1%
		Change	(29.0%)	(29.0%)	(29.0%)	(29.0%)	(29.0%)	(29.0%)	
	2008	Rail	9,689		3,141	26,554		39,383	11.0%
	2018	Rail	7,262		1,985	18,298		27,545	10.9%
		Change	(25.0%)	0.0%	(36.8%)	(31.1%)	0.0%	(30.1%)	
	2008	Combined	19,803	99,167	128,671	109,440	50	357,130	
	2018	Combined	14,443	70,407	91,132	77,146	35	253,163	
		Change	(27.1%)	(29.0%)	(29.2%)	(29.5%)	(29.0%)	(29.1%)	
Norfolk	2008	Truck	3,332	36,329	3,875	51,597	222	95,356	39.4%
	2018	Truck	2,337	25,479	2,718	36,187	155	66,876	38.5%
		Change	(29.9%)	(29.9%)	(29.9%)	(29.9%)	(29.9%)	(29.9%)	
	2008	Rail	74,318		6,101	28,855	37,552	146,825	60.6%
	2018	Rail	55,532		4,307	20,686	26,336	106,861	61.5%
		Change	(25.3%)	0.0%	(29.4%)	(28.3%)	(29.9%)	(27.2%)	
	2008	Combined	77,650	36,329	9,976	80,452	37,773	242,181	
	2018	Combined	57,869	25,479	7,024	56,873	26,492	173,737	
		Change	(25.5%)	(29.9%)	(29.6%)	(29.3%)	(29.9%)	(28.3%)	
Gulfport	2008	Truck	3,486	32,384	45,648	33,297		114,816	90.6%
	2018	Truck	2,525	23,454	33,060	24,115		83,154	89.9%
		Change	(27.6%)	(27.6%)	(27.6%)	(27.6%)	0.0%	(27.6%)	
	2008	Rail	3,358		348	8,176		11,881	9.4%
	2018	Rail	2,410		220	6,684		9,314	10.1%
		Change	(28.2%)	0.0%	(36.6%)	(18.2%)	0.0%	(21.6%)	
	2008	Combined	6,844	32,384	45,996	41,473	0	126,697	
	2018	Combined	4,934	23,454	33,280	30,799	0	92,468	
		Change	(27.9%)	(27.6%)	(27.6%)	(25.7%)	0.0%	(27.0%)	
Freeport	2008	Truck	3,566	42,265	18,177	12,107		76,114	79.3%
	2018	Truck	2,547	30,183	12,981	8,646		54,356	81.7%
		Change	(28.6%)	(28.6%)	(28.6%)	(28.6%)	0.0%	(28.6%)	
	2008	Rail	2,695		17,217			19,911	20.7%
	2018	Rail	1,876		9,558	770		12,204	18.3%
		Change	(30.4%)	0.0%	(44.5%)	0.0%	0.0%	(38.7%)	
	2008	Combined	6,261	42,265	35,393	12,107	0	96,026	
	2018	Combined	4,423	30,183	22,539	9,416	0	66,560	
		Change	(29.4%)	(28.6%)	(36.3%)	(22.2%)	0.0%	(30.7%)	
Others	2008	Truck	2,467	21,717	18,077	23,632		65,893	57.9%
	2018	Truck	1,844	15,892	13,580	16,994		48,310	64.6%
		Change	(25.3%)	(26.8%)	(24.9%)	(28.1%)	0.0%	(26.7%)	
	2008	Rail	20,504	5,110	3,287	16,738	2,309	47,948	42.1%
	2018	Rail	8,324	3,222	1,705	11,894	1,289	26,434	35.4%
		Change	(59.4%)	(37.0%)	(48.1%)	(28.9%)	(44.2%)	(44.9%)	
	2008	Combined	22,971	26,828	21,364	40,370	2,309	113,841	
	2018	Combined	10,168	19,114	15,286	28,888	1,289	74,744	
		Change	(55.7%)	(28.8%)	(28.4%)	(28.4%)	(44.2%)	(34.3%)	
International Total	2008	Total	1,298,178	4,940,417	3,197,623	2,613,929	73,383	12,123,529	
(No Mexico or Can)	2018	Total	1,281,255	4,171,301	2,695,073	2,259,081	58,640	10,465,349	

Source: Transearch 2008 Commodity Movement Database, reported on 480 pound statistical bales.

Summary of Findings – Flow Analysis

Based on the Transearch™ dataset, in 2008 approximately 16.9 million bales of cotton were transported in the U.S. Of those, 3.6 million bales were shipped between domestic origins and destinations. Exports were recorded at 13.3 million bales, of which 1.2 million bales crossed the borders with Canada and Mexico and 12.1 million bales were shipped to Overseas' markets.

The Transearch forecast for 2018 indicates that domestic shipments will decrease 56.9 percent (which is an 8.8 percent negative compound annual growth rate) and exports will decrease 15.7 percent (a 1.7 percent negative compound annual growth rate).

Market projections are always subject to uncertainties relating to changing agricultural, economic, and policy influences. The Transearch 2018 forecast and the Food and Agricultural Policy Research Institute (FAPRI) forecast both predict an overall decline in bale consumption. However, the USDA Outlook for 2018 forecasts a slight growth during the same period. Due to the variation in forecasts, the study focused on the 2008 data to analyze freight flows.

Exports to Asia at 5.4 million bales represent 40.5 percent of total bales shipped Overseas. Southeast Asia was at 2.9 million bales or 21.4 percent. The Middle East was at 1.9 million bales or 14.1 percent. These top three destination markets represented 76 percent of total exports shipped Overseas. Mexico and Canada totaled 1.2 million bales or 8.7 percent of the total bales shipped to international destinations.

China was the largest receiver of U.S. export bales at 4.02 million, followed by Turkey at 1.84 million bales, Indonesia at 1.19 million bales and Mexico at 1.11 million bales.

By cotton producing region, the Southwest was the largest shipper region with 6.3 million bales for 37.4 percent of the total shipped; the Mid-South shipped 4.8 million bales for 28.3 percent, the Southeast shipped 4.0 million bales for 23.6 percent, and the West shipped 1.7 million bales for 10.1 percent.

The top four ports handling exports of cotton represented 89.8 percent of the total. Los Angeles (Ports of Los Angeles and Long Beach) handled 7.2 million bales for 59.3 percent, Savannah handled 1.69 million bales for 13.8 percent, Houston handled 1.46 million bales for 12.1 percent and Charleston handled 432,000 bales for 3.6 percent.

By mode of transportation, rail moved 5.7 million bales to Los Angeles mainly due to the long distances from the cotton producing regions to the Pacific Coast. Since the major cotton producing regions are closer to the southeastern ports, truck was more than two thirds of the time to move bales to the ports. Trucks moved 1.2 million bales to Savannah, 1.2 million bales to Houston and 0.3 million bales to Charleston.

Analysis of Changes to Freight Patterns

The study team investigated changes in freight patterns and how these changes will likely impact cotton flows. This investigation focused on areas where cotton transportation costs could be reduced.

Equipment Balance

The key concept for intermodal transportation is equipment balance. Where loaded containers go for delivery, usually to densely populated areas, after being emptied, that location is where the empty containers are made available for reloading with exports. Rural and agricultural areas with lower population density have less demand for inbound freight, receive fewer loaded inbound containers and consequently have fewer empty containers available for reloading. This critical issue is faced by agricultural exports such as cotton and grains.

When empty containers are in demand in rural areas for loading with agricultural export freight, a supply of empties must be pulled into the deficit area from a surplus area. There is a cost for pulling the empties to the desired location. The cost of the empty inbound move, which must be added to the shipper's overall transportation cost, is the major reason why using containers to export products out of rural areas is more challenging and costly than exporting from populated areas that have consolidation centers and a more adequate supply of empty containers.

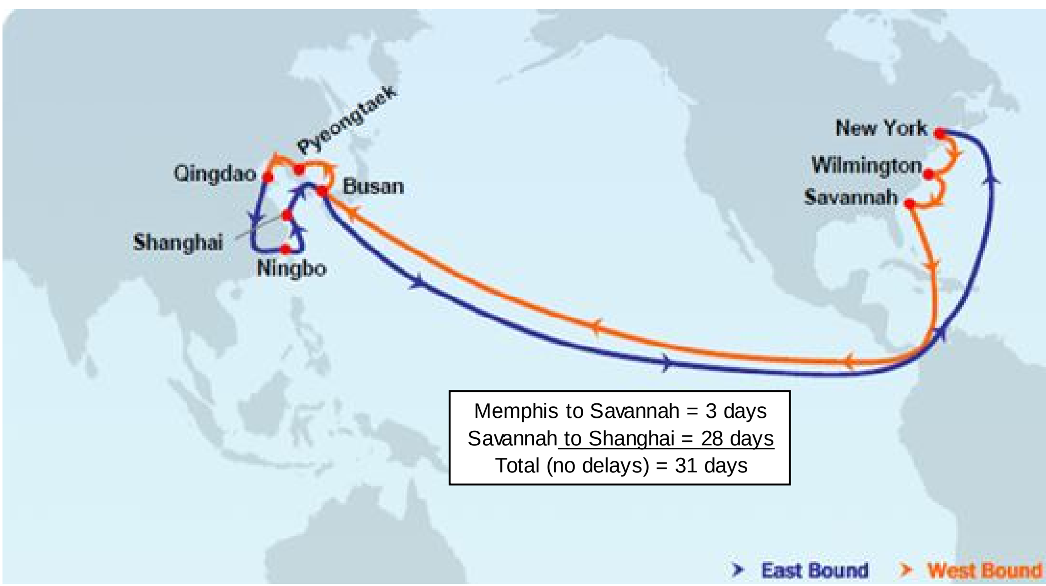
North American Gateways

As shown above, the Ports of Los Angeles/Long Beach (LA/LB), otherwise known as the San Pedro Bay Ports, handle about 59 percent of U.S. cotton exports. California ports have been relatively dominant, not only for cotton, but a variety of import and export trade with Asia. However, labor issues at the LA/LB in 2004/2005 and driver slowdowns at Oakland and Stockton, CA in 2008 prompted shippers and consignees to search for alternatives for their international trade flows. They have adopted what is termed the "four corners approach" to diversify the risk of importing the majority of freight through the LA/LB. This approach uses port access in the Pacific Northwest, the Atlantic East Coast and the Gulf of Mexico to complement flows through LA/LB. A key example is Wal-Mart. As of 2009, it has diverted 85 percent of its Asian inbound freight away from the LA/LB. Wal-Mart has built over two million square feet of warehouse distribution space in Houston, TX. Other large importers have followed Wal-Mart's lead and have investigated using the Panama Canal or the Suez Canal to bypass San Pedro Bay. Many have now built warehouses clustered around the alternative ports along the east coast to receive their freight via all-water vessel service and avoid the west coast ports and possible inland rail delays.

Containers typically have to exit the country through the same port of entry to maintain a balanced equipment flow on trains and vessels. The Panama Canal Expansion, the Suez Canal express and the Port of Prince Rupert/CN intermodal service will increase the number of containers arriving in the U.S. Midwest, Northeast, Southeast and Mid-South via ports other than LA/LB. Increased inbound container flows via Panama, Suez and Prince Rupert imply fewer containers railed between LA/LB and these markets. A negative impact will be fewer ISO containers available for exports for transit through the LA/LB ports possibly driving up their cost. The positive impact will be the increased number of empty containers for export in the Southeast and Mid-South that must exit the U.S. via Southeastern or Gulf ports, or Prince Rupert. This could possibly drive down the cost through those ports.

A major alternative to the West Coast-to-Asia trade route is from the U.S. East Coast ports with transit through the Panama Canal to Asia (**Exhibit 47**). This route typically requires containers to be shipped overland to Savannah or another East Coast port. Truck transit from Memphis to the East Coast ports can be accomplished typically in one to two days with maximum of three. The vessel transit duration to Shanghai through the Panama Canal requires 28 days. Total transit duration would be in the range of 31 days, which is 10 days longer than service through Los Angeles, but it would avoid the risk of delays for long-haul rail transit and congested port activities in LA/LB.

Exhibit 47: U.S. East Coast to Shanghai via Panama Canal



Source: Hanjin Shipping Company website schedules

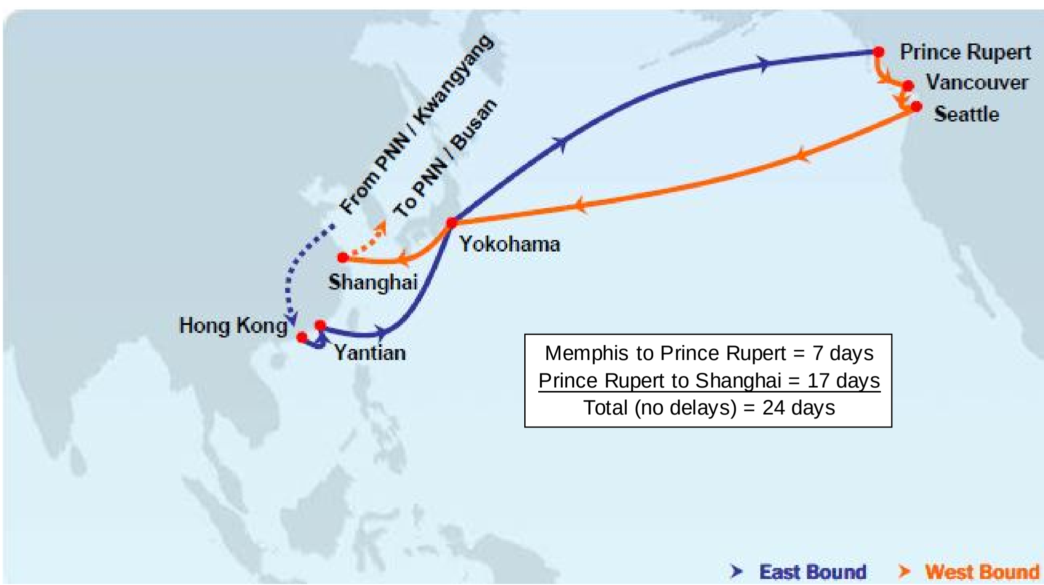
Port of Prince Rupert and CN Rail Service for Chicago and Memphis

A recent improvement in containerized service between northern Asia and the U.S. rounds out the “four corners” strategy. It was the introduction of vessel service calling at the Port of Prince Rupert in British Columbia combined with express double-stack intermodal rail service to Chicago provided by Canadian National Railroad (CN). The service commenced in late 2007, and handled more than 180,000 twenty foot equivalent units (TEUs) in 2008 and handled

260,000 TEUs in 2009. Prince Rupert was the only port in North America to experience growth during the current recession, a testimony to its Shanghai/Chicago express business model. The port's Start-up Phase I was designed to handle 500,000 TEUs annually. In Phase II, the port will be expanded to enable the handling of two million TEUs per year. The inbound service was designed with an emphasis on speed to expedite consumer freight from China to Prince Rupert in 11 days on COSCO and Hanjin containerships and from Prince Rupert to Chicago on CN's express intermodal trains in four days for a total of 15 days. Further service on to Memphis requires an additional two days.

The return journey from Memphis to Prince Rupert requires seven days and the vessel journey to China **(Exhibit 48)** requires 17 days for a total of 24 days. This is four days longer than transit through the ports in Los Angeles. However, the port processing time in Prince Rupert could require less time because the CN has an on-dock rail terminal. Backhaul opportunities for exports in the empty containers are now being explored by the vessel operators. Approximately 30 percent of the containers return to Prince Rupert loaded with exports such as paper and forest products, dry grains, chemicals, processed food, and aluminum. Cotton is not currently a large export commodity but it has potential for the service.

Exhibit 48: Prince Rupert to Shanghai



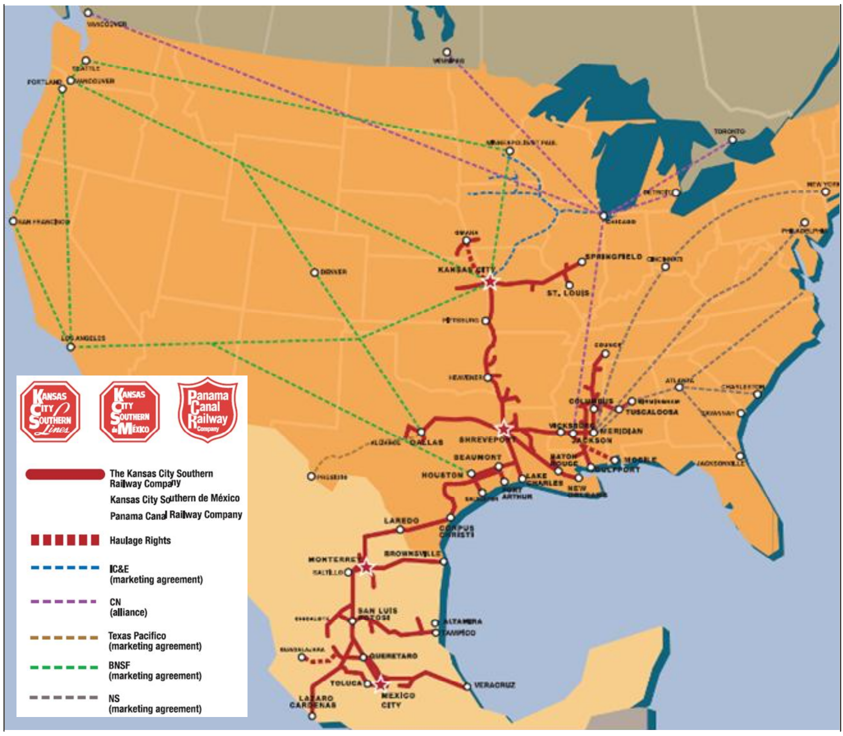
Source: Hanjin Shipping Company website schedules

Lazaro Cardenas

The route from Mississippi to the Port of Lazaro Cardenas could also serve as alternative access to Asia compared to using the ports in California or using the Panama Canal. However, the port and rail linkage both need improvements to handle larger volumes.

The Kansas City Southern (KCS) operates from Kansas City, KS to Laredo, TX **(Exhibit 49)**. KCS serves the central states and has an agreement for rail access to Chicago. KCS also has a rail line that serves the central portion of the Cotton Belt. KCS's sister railroad, the KCSM, extends their freight service down into Mexico. It runs from Nuevo Laredo, Mexico, down to Mexico City anc ... ıt.

Exhibit 49: KCS and KCSM Railroad



Source: KCS website

Panama Canal Expansion

In 2001, the Panamanian Government commissioned a strategic assessment designed to keep the Panama Canal competitively positioned to capture increased international trade and maintain its long-term sustainability as a trade route between Asia and the U.S. east coast ports. A major reason that all-water containerized service between the U.S. east coast and Asia had not increased in prior decades was that the Panama Canal vessel transit capacity is limited to approximately 40 vessels per day in each direction (14,000 vessels per year). Canal Water Time (CWT), the duration it takes for the Atlantic/Pacific transit, averages from 15 to 30 hours – including wait time at the locks.

In 2006, the canal transit was distributed as follows:

- containerships represented 35 percent of the vessels that transited the Canal;
- dry bulk ships represented 20 percent;
- vehicle carrier vessels represented 10 percent; and

- the remaining 35 percent was spread among liquid bulk, reefer, cruise ship, general cargo and miscellaneous (naval and research vessels, fishing vessels, barges, etc.).

Currently, containerships that transit through the Panama Canal are classified as "Panamax". Their size limitations are 965 feet in length, 106 feet in width, and have a draft limitation of 40 feet. Panamax containerships carry approximately 4,500 to 5,000 TEUs. Most freight shipped internationally is transported in forty foot equivalent units (FEUs). FEUs typically number in the range of 70 to 80 percent of containers on a containership. Of the eastbound containerships that transit the canal, approximately 50 percent of containerized freight was destined for the U.S. ports.

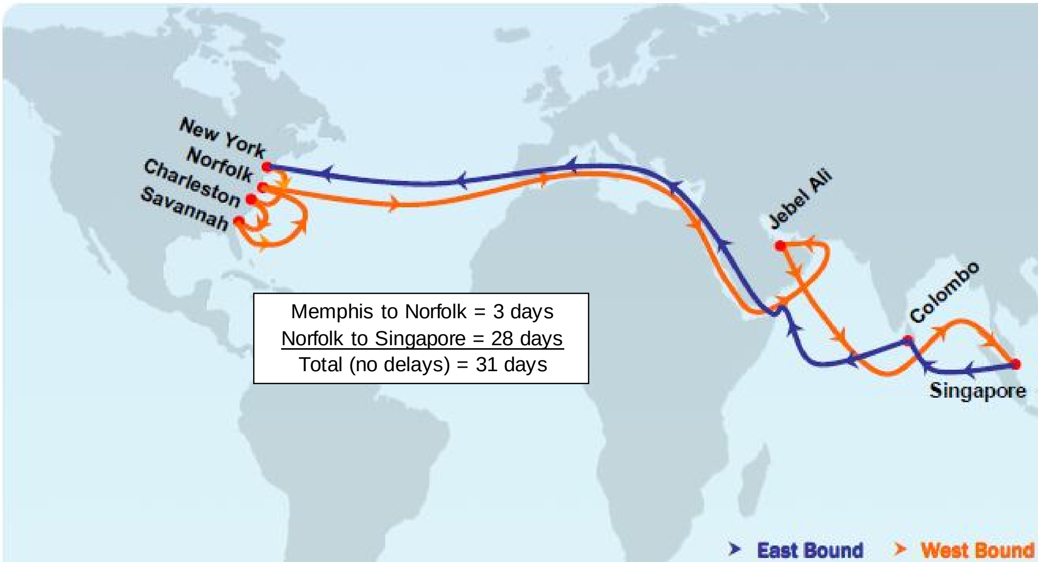
The Panama Canal Expansion project is estimated to cost $5.2 billion. The plan calls for two new lock facilities – one on the Atlantic side and the other on the Pacific side. The plan is to increase the length, width and depth of both locks. The inland canal channels are to be widened to 740 feet and dredged to 51 feet deep to accommodate the next generation of larger "super post-Panamax" containerships. Super post-Panamax containerships are in the range of 1,200 feet long, 160 feet wide, and have a draft of 50 feet. The project is currently under construction and is scheduled for completion in 2015.

The Panama Canal Expansion project will not necessarily allow more vessels to transit the canal but since much larger containerships will be able to transit the Panama Canal, the total number of containers passing through the canal each year more than doubles. A super post-Panamax containership with 12,000 TEUs will carry approximately 2.5 times as many TEUs as a current generation Panamax containership.

All-water Suez Canal Service

Containerships have been transiting the Suez Canal for service between Europe and Asia for decades. However, there has been only minimal service between the U.S. East Coast and Asia via the Suez Canal because the transit time was 32 days or longer. In 2007, The New World Alliance (TNWA) partners of America Presidents Line (APL), Hyundai Merchant Marine (HMM) and Mitsui O.S.K. Lines (MOL) introduced an eastbound express all-water service between the U.S. East Coast and the Indian Sub-Continent or Southeast Asia via the Suez Canal **(Exhibit 50)**. Direct service without any stops in the Mediterranean ports reduces transit time. An eastbound transit schedule is 26 days from Savannah to India and 28 days from Savannah to Singapore. As imports from India increase over the coming years as is forecast, there will be more empty containers available for export back to the Indian Sub-Continent and Southeast Asia.

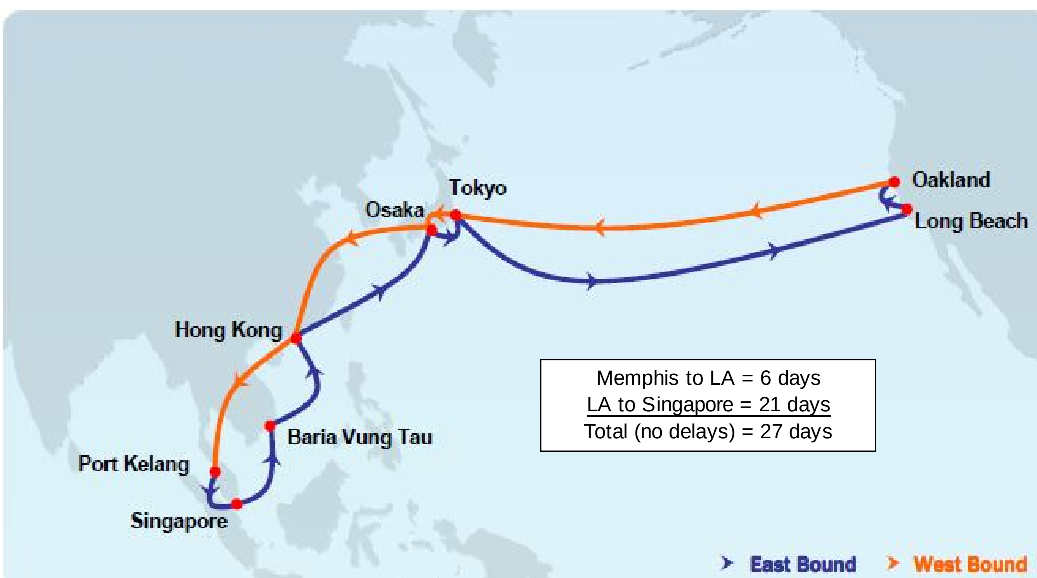
Exhibit 50: U.S. East Coast to Singapore



Source: Hanjin Shipping Company website schedules

In comparison, a westbound shipment from the LA/LB ports to Singapore **(Exhibit 51)** requires 27 days and 29 days or longer to the Indian Sub-Continent. Thus, depending on a container's U.S. overland distance to either Savannah for eastbound transit to Singapore or to Los Angeles for westbound transit to Singapore, the transit duration will be similar in both directions.

Exhibit 51: Los Angeles to Singapore



Source: Hanjin Shipping Company website schedules

Container Weight Issues

The 20-foot long containers are referred to as twenty-foot equivalent units (TEU) and the 40-foot long containers are referred to as forty-foot equivalent units (FEU). Vessel size and port handling capacities are measured in TEUs. These standards were adopted by the International Standards Organization (ISO) in the 1960s. By the mid-1970s, the size, weight and loading practices were adopted worldwide and the modern era of multimodal transportation that integrated vessel, train and truck movements commenced.

Source: Mi-Jack Products, Inc., product web site

From the 1970s through the 1990s, several additional container size standards were introduced to increase the cubic capacity and loading efficiency of global freight shipments. High-cube containers measuring 9-foot 6-inches high were introduced, as well as 45-foot long 8-foot high or 9-foot 6-inch high-cube containers.

In most foreign countries, the weight limitation for freight loaded into a container is in the range of 52,000 to 55,000 pounds. Freight loads in the U.S. weighing more than 45,000 pounds are considered to be over-weight. The 45,000 pound freight weight limitation is based on U.S. highway and bridge design standards. Over-weight containers pulled out of a container or rail terminal can create maintenance issues for local transportation networks. Over-weight containers must be permitted and are required to follow routes that have adequate roadway and bridge construction. The local transportation agency is responsible for preparing truck routes for the over-weight vehicles to follow. Permit fees increase the cost of transportation and a circuitous route can extend the transit duration. An over-weight container is usually placed on a drayage chassis that has an extra axle to distribute the load over a larger roadway surface. Currently, there is growing interest in increasing gross weight limits on highways and the use of the high-cube containers for inter-modal/ocean freight.

The over-weight issue places U.S. cotton exports at a competitive disadvantage. In the U.S., a 40-foot container loaded with 88 500 pound bales of cotton contains 44,000 pounds, which is within the acceptable weight limit for most U.S. highways and bridges. However, in other countries that have a 55,000 pound weight limit, more bales can be loaded into a 40-foot high cube or a 45-foot high cube container. The cost of shipping a 40-foot or 45-foot high cube container is not significantly higher than shipping a 40-foot standard container. Using the heavier weight limits allows containers that hold more bales which reduce the unit cost per bale for transportation, making the competitors' delivered bales less expensive per unit.

Supply Chain Control

Some shippers manage their entire supply chain and others allow freight forwarders or ocean vessel operators to manage their entire supply chain or just parts of it. Other shippers prefer to manage the surface transportation from the warehouse to the rail or port terminal because they can work with local transportation firms that are familiar with local requirements. Warehouse operators typically do not know the destination of cotton shipments. Their responsibility and visibility to the shipment ends after the bales are loaded into the truck trailer or container. However, if the warehouse is part of a merchant's integrated supply chain, the warehouse personnel could have visibility to a shipment's destination information. Warehouse loading issues are explored in more detail in the Warehouse Analysis.

Ocean vessel operators engaged in the export of agricultural products prefer to start container handling at either an intermodal terminal or at the port. Their second preferred engagement point is at a consolidation center from where they can dray the containers to the rail terminal or port. During interviews with ocean vessel operators, they expressed that their centralized dispatch resources work well in the metro areas but are not aware of the many pick-up requirements at numerous rural areas and prefer for the freight forwarders, intermodal marketing companies or local transportation providers familiar with the area to arrange truck transfers to consolidation centers. The railroads' engagement with a container starts with in-gating at an origin terminal to out-gating at the destination terminal or hand-over to a terminal operator at a port.

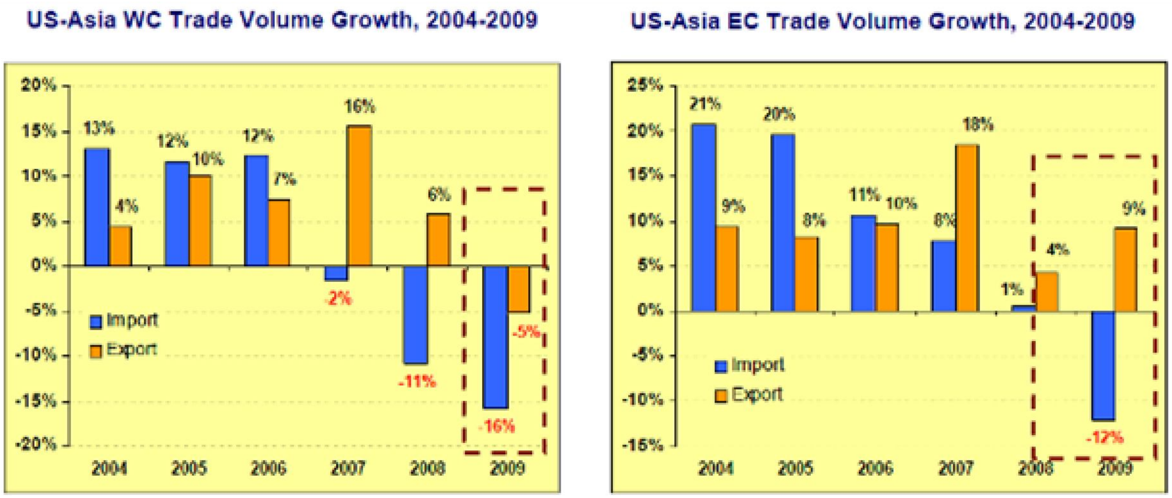
The alternative to draying in empty containers to the cotton warehouse is to transfer the cotton bales to consolidation points that are on rail or port terminals or are close by and have access to empty containers. This approach enables shippers to arrange haulage with carriers that may need backhaul loads which are usually less expensive. It also enables the use of various sized trailers as well as flatbeds.

Not all cotton for export crosses the U.S. in intermodal containers. If speed of delivery is not an issue, then the cotton can move in boxcars. Some warehouses have boxcar access which enables direct loading. Others that do not have boxcar access need trucks to transport the bales to a consolidation point (in a building or open air) for loading into a boxcar. The boxcars are railed to transloading facilities where the bales are transferred into export containers. It is best to transload directly from the boxcar to a container to avoid costs for multiple handling and short-term storage.

Impact of 2009 Recession on International Containerized Traffic

The 2009 recession had a severe impact on U.S.-Asian containerized freight flows. During the 2010 TransPacific Maritime Conference, vessel operators explained how the recent economic slowdown had caused reductions in both imports and exports for container volumes on both the U.S. West and East Coasts **(Exhibit 52)**. The West Coast experienced a 16 percent import reduction and the East Coast had a 12 percent reduction. U.S. exports off of the West Coast decreased 5 percent, but East Coast exports expanded by 9 percent. Overall world trade experienced a 9 percent decline during the recession.

Exhibit 52: U.S.-Asia West Coast and East Coast Trade Volume

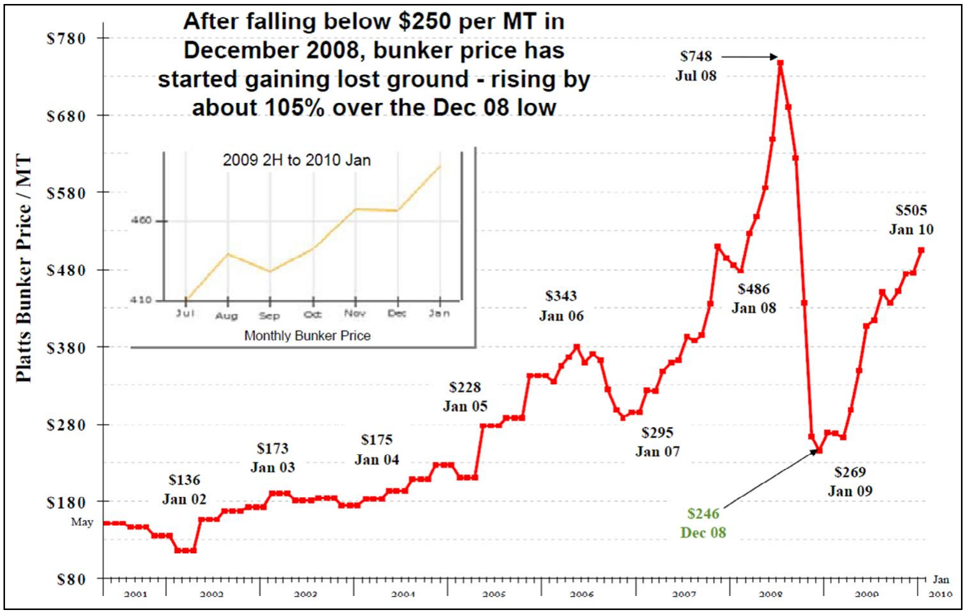


Source: APL presentation, TransPacific Maritime Conference, March 2010

The recent recession introduced a new dynamic in ocean transportation termed slow steaming. During the past decade, the rapid introduction of many new and larger containerships propelled TEU capacity to eventually exceed demand. While international trade grew during the second half of the 2000 decade, the new capacity was being constantly absorbed by the increasing utilization of containers for shipping freight. The 2008/2009 recession changed that. While many of the new containerships were entering service, international trade experienced one of the largest downturns in nearly a century. Worldwide, containerized shipments decreased by approximately 19 percent. This idled over 1.2 million TEU capacity per month in the world's container fleets. At the same time, the cost of bunker fuel climbed, thus raised operating costs. Many vessel operators were losing money and some were faced with reducing or shutting down operations. Over 100 containerships were idled in ports and fjords around the world. With large containership daily operating costs at $20,000 to $40,000, it was easy to see why the maritime industry had to react with cost saving innovations.

The cost of bunker fuel was $295/metric ton in January 2007, peaked at $748/metric ton in June 2008, plummeted to $246 in December 2008 at the peak of the recession and has since risen back to the $500/metric ton range by January 2010 **(Exhibit 53)**. To save fuel costs, vessel speed was reduced from an average of 23 knots/hour to 17-19 knots/hour. Marine engines (and their attached propellers) are generally optimized for 85% of maximum RPM. Above that level, fuel consumption increases rapidly. Much below that level (current slow-steamers are operating at 70%) and even modern, electronically controlled engines see significant drop off in combustion efficiency. Slow steaming can result in a fuel saving of approximately 5 to 7 percent including the cost of the additional vessels in the string and extra container lease costs.

Exhibit 53: Price Changes in Bunker Fuel



Source: APL presentation, Transpacific Maritime Conference, March 2010

Slow steaming may save fuel, but it also increases the transit duration and requires the addition of a vessel or two into the strings to keep the freight flowing without gaps in the delivery schedules. The longer the transit distance, the greater will be the savings. Thus slow steaming has been adopted for the Asia-Panama Canal-East Coast port routes. Only a few vessel operators use it in their Asia-West Coast port routes because the distance is too short to produce enough fuel savings to cover the cost of inserting an extra vessel into the string.

Another reason for not utilizing slow steaming in the Asia to West Coast trade lane is inbound velocity. Commodities such as apparel, electronics, consumer items, food, etc. have a shorter shelf life and need to get to market as fast and economically as possible. Asia to Memphis via the Los Angeles or Long Beach Ports requires approximately 20 to 22 days. Asia to Memphis via the Panama Canal and the Port of Savannah requires 28 to 30 days. Higher velocity commodities will use the Southern Californian gateway. Lower velocity commodities (non-seasonal goods, replenishment items, bulky or heavy products) will use the Panama Canal trade lane because slower service is usually less expensive service.

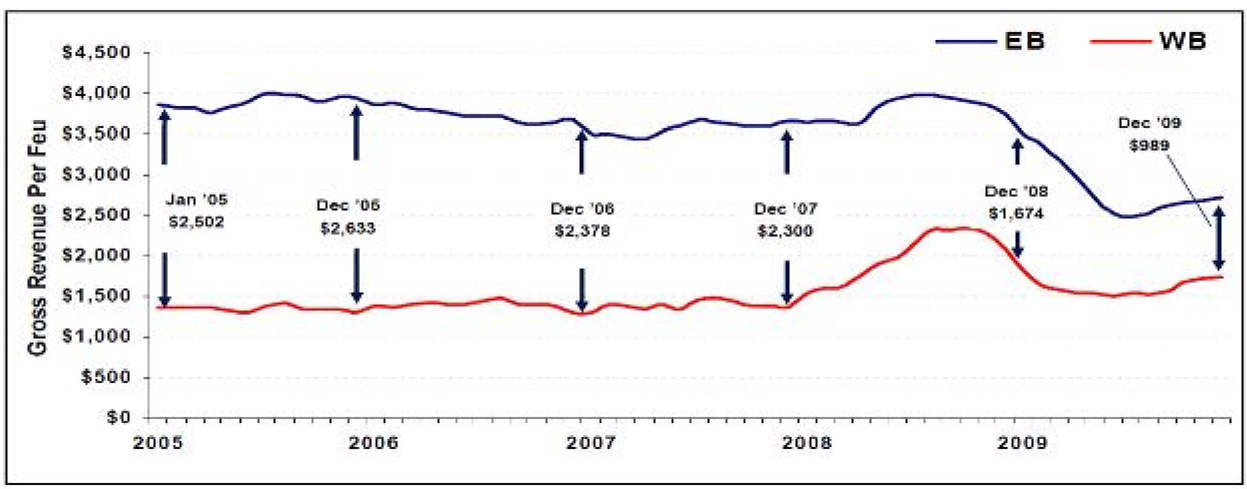
As discussed in Tech Memo #1, outbound transit time from Memphis to Shanghai via Los Angeles is approximately 20 days (excluding a variable number of days at the port for vessel loading) and there will not be an increase in transit time because this is not a slow steaming lane. Memphis to Shanghai via Savannah was forecast at 31 days (excluding port days) before the advent of slow steaming. If slow steaming is utilized, vessel day duration via the Panama Canal could increase by 15 percent or more, or 5 additional days for Savannah to Shanghai. This will increase the overall duration to 36 days. To compensate for longer shipping times, ocean carriers will need to adjust container rates slightly lower to off-set the increase in inventory carrying costs for the cotton plus the longer time for the cotton to reach Asian markets.

Shippers will have the traditional option of sending cotton exports to Asia via land-bridge through LA/LB or the new option, the East Coast via the Panama Canal. They will need to clearly communicate to their Asian customers the realistic amount of time needed with slow steaming. Setting realistic expectations on transit time will overcome misunderstandings on transit duration from the East Coast.

With the introduction of the faster service using CN's land-bridge service to Prince Rupert to Asia, shippers will have three options with varying service levels for shipping to Asia. Pricing for the service options will depend on the economy, price of fuel, time of year, volume of shipments and other factors, all of which vary.

Westbound and Eastbound rates which typically have a $2,300 spread **(Exhibit 54)** due to the larger amount of imports to exports, has collapsed to under $1,000 as a result of the recession. Granted, with the recession alleviating, the spread will gradually increase to the historical range as more demand grows for eastbound container freight. The chart also indicates that, except for 2008 when there was a U.S. export surge due to a declining dollar value, Westbound rates held in the $1,500 range.

Exhibit 54: FEU Rate Comparison Eastbound and Westbound



Source: APL presentation, Transpacific Maritime Conference, March 2010

The export container rates shot up more as a result of vessel loading than container availability. Inbound containers typically carry lighter freight such as electronics and consumer goods and weigh about 21,000 pounds, while outbound containers usually carry heavy commodities such as scrap, paper, and cotton, and typically weigh over 41,000 pounds. The heavy weight outbound containers consume the containership's weight capacity, restricting the number of containers that can be loaded. With restricted loading conditions, container rates rise as shippers accept increasingly higher rates to get their freight loaded onto the vessels. The eastbound rates are driven by container numbers while the westbound rates are driven by container weight.

Thus it is the size, capacity and weight of containers that drives efficiency.

Chapter 3: Least Cost Modeling

Prior to the mid-1990s, most of the U.S. cotton production was mainly trucked or railed in boxcars to southeastern domestic mills[16]. A major shift towards globalized fiber and textile markets in the 1990s saw a contraction of the U.S. cotton textile industry, the concurrent development of an export-based cotton marketing system, and the dominance of Far East imports and textile production. U.S. cotton exports increased from 3 million bales in 1999 to about 15 million bales by 2005. Today approximately 80% of U.S. cotton production is exported, mostly to China, and almost all of it transported in marine containers. Mill use in the U.S. has stabilized over the last several years around the 3.5 million bale consumption level. The shift of the U.S. cotton industry toward exports has imposed structural shifts on regional shipping systems. The purpose of this analysis is to characterize 2008 U.S. regional cotton flows using a detailed economic framework that models cotton flows from country warehouses to specified domestic and export locations in patterns that minimize shipping and handling costs.

Least Cost Model

Anecdotal evidence from cotton shippers is that cotton shipments tend to "flow like water", that is, they flow in a pattern of least resistance and least cost. Obviously, this pattern is subject to specific influences such as:

- supply/demand for particular qualities;
- private contract delivery requirements;
- relationships between various business entities;
- integration of farm, gin, and/or warehouse ownership;
- futures contract delivery requirements;
- availability of suitable transportation options;
- credit availability; and
- federal farm program considerations.

Viewing cotton flows in least cost terms provides a "big picture" of the major economic forces and trends. A consistent, solvable, repeatable least cost model is useful to analyze selected "what if" scenarios. These potential solution scenarios are examined in further detail in the document.

[16] Robinson, J. R. C., J. L. Park, and S. W. Fuller. 2007. "Cotton Transportation and Logistics: A Dynamic System." Transportation Research Forum. 2007 Annual Forum Proceedings. www.trforum.org/forum/2007/schedule.php accessed 11/20/07.

The model applies a detailed cost minimizing mathematical programming model that was developed by agricultural economists at Texas A&M University[17] to represent the U.S. cotton transportation and logistics system. The model's framework minimizes the total cost of shipping, handling, and storing cotton that originates at 673[18] gins and flows to over 443[19] warehouses across the U.S. over four quarterly periods. The first quarter (Q1) corresponds to the August-October period which marks the beginning of the cotton marketing year with estimated carry-in stocks allocated to warehouses and early new crop supplies allocated to relevant gins based on 2008 USDA-NASS regional production and AMS classing data. New crop supplies were allocated to gins in Q2 and Q3 based on 2008 USDA- National Agricultural Statistics Service (NASS) regional production and AMS classing data. AMS classing data for West Texas shows that about 10% of expected new crop supplies arrive during the August-through-October quarter, 80% arrives during November through January, and 10% in February and March.

Historical storage is incorporated into the model in two ways. The aggregate amount of 2008-09 season carry-in (i.e., carryover from the previous marketing year) was allocated to states using Bureau of Census data, and then to warehouses in each state proportionally by warehouse capacity. Season ending carryover stocks were likewise characterized in the aggregate by the USDA-NASS data, but these carry-out stocks were allocated to warehouses in a least cost fashion as Q4 storage.

The model allows for routing cotton shipments from originating gins to warehouses, possibly through reconsolidation warehouses in Memphis or Atlanta, and then on to either sixteen U.S. ports, eleven domestic mill regions, or four major intermodal facilities (and thence by rail to major West Coast, Gulf and East Coast ports). Boxcar shipments are allowed between two Mid-south origins (Memphis and Monroe, LA) and Laredo, TX. The other intermediate and end-points are presented in **Exhibit 55**.

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[17] Fraire, Francisco, Pei-Chun Lai, John R. C. Robinson, S. W. Fuller, and John L. Park. 2008. "Least Cost Shipping of West Texas Cotton." *2008 Proceedings of the Transportation Research* Forum, http://www.trforum.org.

[18] Source; USDA

[19] The location and capacity of warehouses was obtained from the Commodity Credit Corporation list of warehouses with a cotton storage agreement. We may therefore be inadvertently excluding some transit and port warehouses. Individual warehouse tariff data (i.e., receiving, loading, and storage costs) were obtained from secondary sources, e.g., Lubbock Cotton Exchange, Memphis Cotton Exchange, and individual warehouse websites.

Exhibit 55: Destination Points

West Coast Ports	Gulf Ports	East Coast Ports	Land Ports	Intermodal Facilities	Domestic Mill Regions
Seattle/Tacoma	Houston	Norfolk	Buffalo	Memphis	Alabama (North and South)
Oakland	Freeport	Charleston	Detroit	Dallas/Ft Worth	Georgia (North and South)
Los Angeles/ Long Beach	New Orleans	Savannah	Laredo	Houston	North Carolina (East and West)
	Gulf Port	Jacksonville	Harlingen/Rio Grande Valley	Lubbock	South Carolina (East and West)
	Mobile	Port Everglades			Tennessee (East)
					Texas (West)
					Virginia (South)

For the Delta region, the model also allows non-Memphis warehouses to ship cotton to Memphis warehouses to reflect the possibility of Mid-South reconsolidation and ICE cotton certification. Another transshipment warehouse was located in Atlanta to reflect the emerging pattern of warehouse-to-warehouse shipments from as far west as Texas to be pre-staged in Atlanta. The Atlanta facility and the Jacksonville, FL port were a consideration in the expanded Panama Canal Scenario (Scenario 3), which is presented later. Lastly, quarterly storage in warehouses is allowed, with Q4 storage representing carryover into the next marketing year.

Source of Inputs for Least Cost Model

Cotton shipments in the model are driven by the pull effect of constraints that require historical amounts to be delivered to the final demand points (i.e., ports and mills). Secondary export data were compiled by WISERTrade[20] to characterize cotton demand at ports for 2008. Census data was used to allocate 2008 U.S. mill use to the eleven sub-state regions (mostly in the southeastern U.S.). The model then ships and stores cotton every quarter to satisfy the imposed demands while minimizing specified costs.

Road mileages for trucking between originating gins, warehouses, intermodal facilities, ports, and mill locations were calculated using standard mapping software. Railroad mileages between intermodal or boxcar origins and port destinations were obtained from relevant railroad industry websites. Trucking cost base rates and fuel surcharges were developed based on information collected from various industry sources. The data were used to estimate statistical relationships

[20] WISERTrade State Exports by HS Database: data from U.S. Census Bureau Foreign, Trade Division
Source: http://www.wisertrade.org

between trucking mileage and cost. The resulting regression parameters were used to derive point estimates of trucking costs for the specific distance matrix elements for all gin-warehouse, warehouse-intermodal, warehouse-port, and warehouse-mill combinations. Shipping costs from intermodal points to ports were calculated using rail mileage multiplied by the average representative railroad rates obtained from the Surface Transportation Board, railroad industry representatives, and cotton shippers.

Least Cost Modeling Results

Eight different modeling scenarios were examined:

- Scenario 1: pure least cost scenario;
- Scenario 2: the least cost scenario adapted to produce a "Realistic Baseline Scenario" using constraints to force certain current flow patterns that result due to underlying complexities in the cotton marketing system (a compare/contrast of these two scenarios highlights issues related to reconsolidation of cotton in the Mid-South);
- Scenario 3: the cost and flow impacts of Panama Canal expansion on the Realistic Baseline are examined;
- Scenario 4: feasibility of expanded intermodal capacity using Lubbock, TX, as a case study;
- Scenario 5: the cost and flow impacts of a two million bale increase in production across the Mid-South and Southeast; and
- Scenario 6: the cost and flow impacts of an increase in energy costs;
- Scenario 7: fewer Mid-South country warehouses; and
- Scenario 8: reduced Mid-South country warehouse storage rates.

Scenario 1: Pure Least Cost

A pure least cost version was generated which contained no constraints on flows other than an 800,000 bale cap on the Lubbock intermodal flow (to characterize the capacity limit of that one existing facility). The pure least cost results exhibited expected least cost behavior similar to that described by previous research. For example, truck shipments to mills or ports tended to be sourced from cotton warehouses relatively close by. The truck distances between warehouses and mills ranged from under 100 miles (e.g., Alabama warehouses shipping to Alabama mils) to over 600 miles (e.g., Missouri warehouses shipping to N. Carolina mills). Bales in storage, including Q4 carry-out stocks, tended to be located in relatively remote warehouse locations, i.e., where it is relatively expensive to ship from. Because of this, the pure least cost pattern resulted in zero carryover stocks in Memphis-area warehouses, which is unrealistic given the known patterns of storage and certification by Memphis warehouses. However, it is a logical least cost result for a location like Memphis which is a major transportation hub with relative low intermodal rates to the west coast. Least cost Q4 storage was concentrated in relatively remote regions like West Texas and Missouri, as well as Southeastern warehouses where a lot of local excess supply appears to have a harder time getting to market.

The pure least cost scenario also resulted in zero warehouse-to-warehouse shipments, which would be expected given the added receiving and loading costs. In this manner, Memphis-area warehouses receive new crop cotton directly from gins in the North Delta region under the least cost scenario. Cotton otherwise tended to flow from gins to nearby warehouses, unless relative differences in warehouse tariffs or capacity constraints direct the flow to an adjacent warehouse. There was a small amount of warehouse-warehouse shipment from the Mid-South to the Atlanta transshipment warehouse, doubtless because of the lower warehouse tariffs hypothesized for this facility.

Intermodal shipments tended to follow known patterns, except for no projected intermodal shipments from Memphis to Savannah. The model also produced no boxcar shipments from the Mid-South to Laredo. Both of these results were probably influenced by the relative truck/intermodal rates used (circa 2008-2009) which favored trucking over rail.

In contrast to the least cost outcome, some U.S. cotton flows occur because of other marketing behavior beyond minimizing shipping, handling and storage costs. The best example is merchant reconsolidation of cotton from original warehouses to secondary warehouses to ensure a timely supply of given qualities, as well as the ability to group like qualities. Another example might be flows from the Mid-South, as well as the Southeast, to U.S. domestic mills to ensure the proper blend of fiber qualities. Also, storage patterns deviate from the least cost pattern for the same reasons as well as from the influence of the futures certification process. To better reflect these realities, a "Realistic Baseline Scenario" was created, which is discussed in more detail below.

Aside from these realistic constraints, it is still interesting to see how cotton would flow in a pure least cost world, e.g., if one cost minimizing manager ran the existing infrastructure. Because of the strategic nature of Memphis as a transportation center, U.S. cotton flows are least expensive when Mid-South gins ship directly to Memphis warehouses. In times of excess supply, it is still cheaper to satisfy export demand off the West Coast with relatively more intermodal shipments from Memphis, implying carryover stocks will tend to collect in West Texas.

Scenario 2: Realistic Baseline and Costs of Reconsolidation

This scenario is an adaption of the least cost scenario. Underlying influences on cotton flows are implemented using constraints to force, or limit, certain flows. The model reacts by exhibiting least cost behavior subject to the overarching constraints. The specific constraints imposed in this scenario were the following:

- Limiting the direct inflow of cotton from regional Mid-South gins into Memphis warehouses by 90% to reflect patterns and economic relationships between growers and local warehouses;

- Forcing an extra 25% of normal outflow through Memphis warehouses, to reflect existing warehouse-to-warehouse reconsolidations, the greater turnover of cotton through Memphis warehouses, and the mix of Mid-South cotton flowing into the Southeast; and
- Forcing a minimum of 1,000,000 bales of Q4 storage in Memphis transshipment warehouses.

The first two constraints were necessary because the least cost model would not choose to source cotton from another warehouse (except in the limited case of the Atlanta facility). This highlights the additional cost side of reconsolidating cotton from country warehouses to Memphis warehouses. There are obviously benefits from reconsolidating cotton in terms of timely market access, but these commercial factors are difficult to quantify in terms of cost. Another benefit to reconsolidation involves the ability to assemble more uniform shipments which allows shippers to sell at a higher basis and reduces quality complaints after the sale. Lastly, there is the benefit of certificating cotton bales for delivery against futures contracts. Certificated bales require extra grading and special storage in delivery locations (of which Memphis is the dominant location). Unlike some of the previously mentioned benefits of reconsolidation, storing certificated cotton can have clear monetary benefits under conditions of "market carry", i.e., when the difference between nearby and forward futures prices more than covers the cost of storage and certification. For example, during the spring of 2008, December '08 cotton futures traded over five cents higher than the July '08 contract. That spread equates to 100 pts per month for the five months of carry between the July and December delivery period, which is well above the costs of storing certificated cotton. Also, since carry in the market far exceeded actual storage fees, it allowed shippers to roll physical cotton to forward month delivery periods with all their cost covered by the market and in some cases at a benefit. Rolling cotton to benefit from carry conditions is particularly beneficial in one's own consolidation warehouse. Hence, there was a significant economic benefit to those firms that could finance the cost of certification and storage during that time period. This example is another rationale for forcing Q4 storage in Memphis warehouses.

When the pure least cost solution is constrained with a realistic requirement of shipping an extra 25% of outflow through Memphis warehouses, the cost impact from the model to the whole system is $0.32 per bale of Memphis outflow **(Exhibit 56, Column 5)**. That cost can be explained as the model not being able to source cotton less expensively for southeastern destinations from southeastern sources, or for Laredo from southwestern sources. By imposing a 90% reduction on the inflow into Memphis warehouses from their usual regional gins Memphis warehouses are forced to source cotton from other regional warehouses, which incurs additional warehouse costs. This implies an additional cost of $2.53 per bale for Memphis outflow **(Exhibit 57, Column 5)**. Summing these two marginal increments gives $2.85 per bale cost associated with reconsolidation, assuming no other adjustments. Forcing a one million bale carry-out in Memphis warehouses further requires the model to source former Memphis origins from more expensive locations, adding extra costs of $4.90 per bale of Memphis outflow **(Exhibit 57,**

Column 5). In summary, the total increase in cost from Memphis being a point of transshipment and long-term storage is $7.75 per bale of Memphis outflow ($0.32+$2.53+$4.90), compared to a pure least cost situation.

In terms of all 22.1 million bales supplied in the model, the change in cost between the Least Cost and Realistic Baseline scenarios is only pennies per bale **(Exhibit 57, Column 2**). This analysis does not address the benefits (via timely shipments, sales terms, uniform lots, business-to-business relations, etc.) of reconsolidation or carryover stocks at Memphis.

Exhibit 56: Least Cost Model Scenario Options

Scenario Type	Per Bale[21] Shipping and Handling Cost	Aggregate Shipping and Handling Cost	Marginal Cost	Change per Bale of Memphis Outflow
Pure Least Cost	$30.02	$663,525,825		
Additional Extra 25% Memphis Outflow	$30.07	$664,729,006	$1,203,181	$0.32
Additional 90% Restriction on Gin Inflow to Memphis	$30.51	$674,271,038	$9,542,032	$2.53
Additional Forced 1mil bales of Memphis Carryover (Realistic Baseline)	$31.34	$692,746,678	$18,475,640	$4.90

Exhibit 57: Least Cost Model Scenario Options

Scenario Type	Intermodal Bales	Total RR Costs	Total Truck Costs	Total Storage Costs
Pure Least Cost	6,087,180	$79,603,920	$161,451,700	$302,329,100
Additional Extra 25% Memphis Outflow	6,310,341	$82,053,970	$157,596,300	$302,977,300
Additional 90% Restriction on Gin Inflow to Memphis	6,032,167	$78,958,430	$161,403,400	$301,026,600
Additional Forced 1mil bales of Memphis Carryover (Realistic Baseline)	6,173,116	$80,689,650	$164,288,900	$308,814,200

[21] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

Realistic Baseline Scenario reflects much of the underlying cost minimization behavior of the Least Cost Scenario, and that has an influence on the resulting flows. To summarize by region, the Realistic Baseline Scenario reflects the major U.S. flow patterns in **Exhibit 58** and **Exhibit 59**:

- Southeastern supplies largely stay within their region, and are mostly trucked to domestic mills or Atlantic ports;
- Mid-South supplies flow by truck to mills in the Southeast, and also to Atlantic, Gulf, or border demand points, and lastly by intermodal to West Coast demand points such as ports. As trucking costs increase relative to intermodal, more Mid-South supplies flow eastward to port by intermodal;
- Southwest (Texas) supplies flow mostly by intermodal to West Coast demand points, and by truck to Gulf or Mexican border demand points; and
- Far West supplies flow by truck to West Coast demand points.

Exhibit 58: Bale Flows by Truck from Warehouse-to-Port and Intermodal-to-Port

Origin Region Port Destination	Mid-South	Southeast	Southwest	West
Savannah	1,875,051	1,418,410		
Charleston		447,130		
Norfolk		272,185		
Buffalo	1,832	1,827		
New Orleans	231,459	137,914		
Houston/Galveston	526,492	90,174	900,303	
Laredo			890,290	
LA/LB	1,463,717		1,980,008	1,417,458
Oakland/SF			120,458	311,480
Seattle/Tacoma	24			
Detroit	3,116	903		
Gulfport	120,772	10,763		
Mobile	8,997	23,673		
Freeport			100,052	
Rio Grande Valley			442,939	
Port Everglades		44,254		
Regional Totals	4,231,460	2,447,233	4,434,050	1,728,938

Exhibit 59: Warehouse-to-Mill Bale Flows by Truck from Region of Origin

Mill Region Destination:	Mid-South	Southeast	Southwest	West
Alabama, North	56,400	125,201		
Alabama, South	63,831	104,567		
Georgia, North	94,884	284,653		
Georgia, South	8,079	39,480		
North Carolina, East	89,589	412,039		
North Carolina, West	864,070	945,497		
South Carolina, East	9,255	198,470		
South Carolina, West	11,279	33,838		
Tennessee, East	31,736	36,226		
Texas, West			119,384	
Virginia	21,875	65,625		
Regional Totals	1,250,998	2,245,596	119,384	0

Scenario 3: Panama Canal Expansion

This scenario involves reallocating foreign demand that would otherwise flow through the West Coast ports to the ports of Charleston and Savannah (and perhaps also to Jacksonville, FL) to reflect increased passage of container ships to Asia following the Panama Canal expansion in 2014[22]. Such an event would shift the supply and demand of ships and containers toward the Gulf and Atlantic ports, and the potential for surplus ocean containers available in the East would presumably cause a decrease in backhaul ocean rates for Asian-bound cotton exports. This scenario was implemented in the model by simply reducing 2008-09 foreign cotton demand from U.S. West Coast ports by 10% (0.788 million bales). Eighty percent of this 0.788 million bales was reallocated between the ports of Charleston and Savannah in proportion to their current export shares. These two ports are already major cotton exporting centers. The remaining 20% of this 0.788 million bales was allocated to Jacksonville. All three of these ports represent locations where post-Panamax container vessels would have deep enough draft to be able to access the berths.

The results of this analysis are intuitive given the least-cost framework **(Exhibit 60)**. In particular, total shipping, handling and storage costs decline (by $6.2 million) as a result of reallocating foreign demand from West Coast ports to the three Atlantic ports. These savings might have been expected given the proximity of cotton production in the Southeast and Mid-South to the Atlantic port outlets. As expected, principal savings are associated with the reduced need to make shipments of extended distances by rail from the middle regions of the U.S. to the West Coast. System rail costs in the model are reduced by about $6.1 million, while trucking

[22] National Cotton Council, 2010 Cotton Flow Study, Technical Memo #1, page 50.

costs increase by $0.7 million since the greater Atlantic port demand can be serviced by more, but shorter, truck hauls in the Southeast. There was also a $0.27 million saving in storage costs due to the fact that both the Least Cost and Realistic Baseline scenarios store some cotton in the Southeast as Q4 carryover. Under the Expanded Panama Canal Scenario, most of these southeastern supplies are now being exported. Lastly, there was no change in the level of Atlanta transshipment as a staging ground for additional exports from Atlantic ports under this scenario.

Exhibit 60: Realistic Baseline versus Expanded Panama Canal

Scenario Type	Per Bale[23] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Total RR Costs	Total Truck Costs	Total Storage Costs
Realistic Baseline	$31.34	$692,746,678	$80,689,650	$164,288,900	$308,814,200
Expanded Panama Canal Scenario	$31.06	$686,507,576	$74,605,590	$164,992,700	$308,540,100
Difference from Baseline	-$0.28	-$6,239,102	-$6,084,060	$703,800	-$274,100

Scenario 4: West Texas Expanded Intermodal Feasibility

In this section, the Realistic Baseline is used to examine the feasibility of different sized intermodal plants in West Texas. There is currently one intermodal facility in Lubbock, Texas, which is reflected in the Realistic Baseline with a one million bale upper limit. Some have argued that the Texas Plains (Lubbock or Sweetwater area) might be a candidate for construction of a new intermodal facility. Currently, large quantities of cotton are now trucked from the Texas Plains back to intermodal facilities operated by UP and BN in the Ft. Worth-Dallas (DFW) area for subsequent shipment in containers to West Coast ports. In view of this, budgets were constructed for four small intermodal facility sizes with annual capacities of 12,000, 14,000, 16,000, and 18,000 containers, respectively, to gain insight on necessary investment levels and the likely cost of operating these facilities. Preliminary analysis indicates necessary investment to range from about $7.4 to $10.2 million depending on facility size. Further, when the four facility sizes are operating at respective volumes of 12,000, 14,000, 16,000, and 18,000 containers, the estimated total costs are shown in

Exhibit 61. Note that a container is estimated at 88 bales and cannot exceed 45,000 pounds.

[23] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

Exhibit 61: Cost per Bale at Hypothetical Intermodal Facilities

	Size of Intermodal Facility			
Containers Processed per Year	12,000	14,000	16,000	18,000
Total Cost per Container	$164	$154	$150	$144
Total Cost per Bale	$1.86	$1.74	$1.70	$1.63

To gain intuition regarding the economic feasibility of investment in small intermodal facilities in rural areas of West Texas, the Least Cost Baseline was modified to represent an expanded intermodal facility location at Lubbock (i.e., to replace the current one). Area warehouses were allowed to ship to the hypothetical intermodal site with drayage accomplished via truck-chassis combinations with charges partially related to distance of haul. Based on waybill and industry sources, this scenario used the per bale rate from Lubbock to West Coast ports that was $1.69 per bale higher than the rate from the Ft. Worth-Dallas area intermodal facilities to West Coast ports. Therefore, a cost disadvantage for the hypothetical intermodal facility in the Texas Plains relative to the Ft. Worth-Dallas area facilities equals to $1.69 per bale.

In general, the results are intuitive and what would be expected. In particular, if the extra cost per bale for investing in this hypothetical West Texas intermodal site were zero (i.e., with zero implied spread above the DFW intermodal rate), the model estimates 2.16 million bales (25,340 containers) would be assembled at the site and shipped to West Coast locations. When per bale costs at the intermodal facility increases (reflected as an increasing spread over the DFW intermodal rate), the following reduction in bale and container processing occurs **(Exhibit 62)**.

Exhibit 62: Impact of Price Increases at Intermodal Terminals

Amount of Increase per Bale	$1.00	$2.00	$3.00	$4.00
Model Predicted Bale Volume	1.94	1.65	0.97	0.73
Containers Required	22,045	18,750	11,023	8,205

The findings suggest there may be some opportunities to reduce cotton transportation costs based on the economic feasibility analysis of these intermodal facilities. For example, if a firm were to construct an intermodal handling facility to accommodate 18,000 containers per year with an estimated per bale cost of $1.63 per bale (see **Exhibit 61** above), the facility could attract in excess of 18,000 containers of cotton if charging the equivalent of $2 per bale. In which case, gross revenues of $176 (i.e., $2 x 88 bales) could be generated per container while incurring costs of $163 per container. These results are preliminary but initial evidence suggests that small intermodal facilities may have some opportunity to reduce cotton transportation costs in selected situations and presumably deserve a more in-depth analysis. There are many variables and uncertainties concerning the investment risk and profitability of an inland intermodal facility. Considerations include:

- truck rates relative to railroad rates;
- availability of equipment/containers;
- seasonality of shipping agricultural products;
- availability of truck capacity compared to railroad equipment in remote locations;
- potential power of oligopolistic competitors to draw intermodal business away from Lubbock or other start-up intermodal facility locations;
- variable energy prices;
- shifts in transportation networks related to the Panama Canal expansion providing more capacity to the East and Gulf Coasts, the Suez Canal all-water service option to the East Coast, and Prince Rupert serving as a new gateway on the West Coast with rail service to the Midwest; and,
- competitive responses from the U.S. West Coast ports and the UP Railroad and BNSF Railway which serve as the inland rail service providers.

Scenario 5: Increased Energy Cost Scenario

The overall cost of transportation, as well as the least-cost choice of trucking versus intermodal, is influenced by energy costs. All things being equal, one would expect that rising energy costs would tend to shift longer hauls away from trucking and toward intermodal. The Realistic Baseline reflects 2008-09 energy costs, which saw a wide range of diesel prices. Thus the different quarterly time periods in the Realistic Baseline had different associated energy costs. To evaluate the effect of more permanent changes in energy costs, the Realistic Baseline was evaluated over a range of diesel fuel costs and associated fuel surcharges. The change in fuel surcharges fed into the model's truck and rail (both intermodal and boxcar) cost equations. The range of diesel prices evaluated included low ($2.10 per gallon), medium ($3.40 per gallon) and high ($4.70 per gallon) diesel prices. Each diesel price was associated with surcharges for trucking cost, intermodal cost, and boxcar shipment cost. All of these surcharges varied directly with the price of diesel.

The results of the energy cost evaluation are shown in **Exhibit 63**. Note that the Realistic Baseline Results are just higher than the "$2.10/gal Diesel" results. The reason is that the Realistic Baseline was dominated by three quarters of low fuel prices following the crash of commodity prices in October 2008. As expected, total shipping/handling costs rise with higher energy costs, but truck costs rise more than intermodal (i.e., intermodal is more fuel efficient). Thus the number of bales shipped intermodally rises with energy costs. In particular, at the two higher diesel prices, an increasing amount of shipments to Atlantic ports are intermodal from Memphis (substituting for trucking). Likewise, the level of Dallas-West Coast intermodal volume increases in tandem with diesel prices, which reduces net truck shipments in Texas. Because of this, the total railroad costs increase with energy costs (because of more rail shipments and higher rail rates), and the total trucking cost decreases (because of fewer truck shipments at higher energy cost levels.

Exhibit 63: Realistic Baseline versus Variable Energy Costs

	Per Bale[24] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Total RR Costs	Total Truck Costs
Diesel at $2.10/gallon	$31.32	$692,252,226	$86,141,400	$158,103,800
Realistic Baseline	$31.34	$692,746,678	$80,689,650	$164,288,900
Diesel at $3.40/gallon	$32.50	$718,260,837	$96,673,600	$172,354,200
Diesel at $4.70/gallon	$33.59	$742,482,227	$107,002,200	$185,422,600

Scenario 6: Increased Mid-South and Southeast Production Scenario

Another consideration of flow issues and potential bottlenecks involves the level of U.S. cotton production. When there are excess cotton supplies in a region, there is a greater potential for transportation bottlenecks in the form of shortages of transportation equipment, congestion, and slower warehouse service. U.S. cotton production has been trending lower over the last four years, in large part due to declining planted acreage in the Mid-South and Southeast regions. This trend has created excess gin and warehouse capacity, and alleviated some of these bottleneck issues. Our modeling baseline reflects the current lower production/excess capacity situation. Scenario 6 examines the effect on flow and costs of a recovery of production in the Mid-South and Southeastern U.S. To implement this scenario, an additional one million bales of production was added to the Mid-South and another million bales to the Southeast. These bales were allocated to gins according to their proportional share of 2008 production in the Realistic

[24] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

Baseline. This amounted to an average 29% increase in allocated production to each gin in the Mid-South and Southeast regions.

The results of increasing production in the eastern portion of the cotton belt had the general effect of lowering rail (intermodal) costs, increasing trucking costs, and greatly increasing storage costs **(Exhibit 64)**. The large increase in storage costs was the easiest to predict as excess regional supplies in eastern states exacerbate the problem of eastern cotton looking for a home. As a result, there is a large increase in Q4 carryover storage in Alabama, Georgia, Missouri, and North Carolina. There is also a large increase in Texas Q4 carryover storage as West Coast demands are more cheaply met by intermodal shipments from ample Mid-South supplies through Memphis. Even with the shift from Texas intermodal shipments to Memphis intermodal shipments, the net intermodal shipments are lower (resulting in lower rail costs). Trucking costs are higher largely because two million more bales are being trucked from gins to warehouses under this scenario. There are other costs associated with increasing supplies, e.g., congestion and equipment availability, which are not incorporated into this analysis, but can be important in terms of cost and timely shipping.

Exhibit 64: Realistic Baseline versus Two Million More Bales East of Texas

	Per Bale[25] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Total RR Costs	Total Truck Costs	Total Storage Costs
Realistic Baseline	$31.34	$692,746,678	$80,689,650	$164,288,900	$308,814,200
Two Million More Bales in Mid-South & Southeast	$32.05	$772,437,173	$78,750,990	$168,009,400	$387,643,400
Difference from Baseline	$0.71	$79,690,495	-$1,938,660	$3,720,500	$78,829,200

Warehouse Network Rationalization

The recent decline in Mid-South cotton acreage has flow implications regarding the sustainability of infrastructure such as gins and warehouses. The least cost model was used to evaluate two additional considerations regarding Mid-South warehouses to determine the cost impact to the overall transportation system of the closure of smaller country warehouses. The least cost model's framework contains:

- point specific information about gin locations;
- warehouse locations; and

[25] Baseline per bale cost is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales; Alternative scenario is calculated with higher supply of 24.1 million bales.

- warehouse rates.

By manipulating these variables in the model, additional scenarios were generated to examine the impacts on shipping and handling costs.

Scenario 7: Fewer Mid-South Country Warehouses

In the analysis, there was no attempt to identify any particular warehouse operation or location for closure. The analysis was conducted on the assumption that higher cost warehouses would close due to competition with less expensive warehouses for lower supplies. Such competition could result from direct shifts in grower business in response to warehouse tariffs. To the extent that grower business is influenced by rebates (which in turn are made up by higher storage costs), a shift away from high cost warehouses might also be induced by merchants bidding lower prices to growers using relatively expensive warehouses (assuming the more expensive warehouses are also perceived to have poorer service). Warehouses in Arkansas, Louisiana, Mississippi, Missouri, and Tennessee (outside Memphis) were sorted by USDA-NASS crop reporting district and by tariffs. Then, in crop reporting districts where there were more than three warehouses, one warehouse with the highest storage rates was closed. (High storage rates tended to also have the highest total combination of receiving, loading, and monthly storage rate.) A total of ten warehouses were closed (about 9% of the total), one each from the following USDA-NASS crop reporting districts: AR30 (northeastern Arkansas), AR60 (east-central Arkansas), AR90 (southeastern Arkansas), LA30 (northeastern Louisiana), LA50 (east-central Louisiana), MO90 (Bootheel), MS10 (northern Delta of Mississippi), MS40 (southern Delta of Mississippi), TN10 (western border of Tennessee), and TN20 (counties east of TN10).

Exhibit 65: Realistic Baseline versus Reduced Country-Warehouses in Mid-South

	Per Bale[26] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Total RR Costs	Total Truck Costs	Total Storage Costs
Realistic Baseline	$31.34	$692,746,678	$80,689,650	$164,288,900	$308,814,200
Fewer Mid-South Country Warehouses	$32.25	$712,869,287	$80,666,740	$192,265,000	$300,853,300
Difference from Baseline	$0.91	$20,122,609	-$22,910	$27,976,100	-$7,960,900

Compared to the Baseline results, the Reduced Warehouses scenario shifted the flow slightly in the area of interest. Incoming cotton supplies from gins were re-routed to other warehouses in the Mid-South. Former outflows from the closed warehouses were replaced by outflows from warehouses and beyond. In the “Reduced Warehouse” scenario the aggregate change in system-

[26] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

wide shipping and handling costs was a $20.1 million increase over the Realistic Baseline **(Exhibit 65)**. The change is mostly due to increased trucking costs, which can be explained as closing country warehouses in particular locations. One outcome of this scenario involves more trucking from gins to more distant warehouses. Aggregate storage costs declined, as would be expected by closing the most expensive warehouses in the region. However, the increase in trucking to more distant warehouses outweighed the saving in storage costs. This suggests that these warehouses in question were strategically located near major cotton sources. The aggregate transshipment flow from country warehouses to Memphis warehouses was unchanged. The aggregate intermodal flow was similar, but this scenario increased Memphis intermodal flow at the expense of Dallas by roughly 100,000 bales, compared to the Realistic Baseline. Compared to the baseline regional cotton flows **(Exhibit 56)**, closing these ten Mid-South country warehouses did not significantly change the overall flow pattern to mills or ports. It should be noted that this type of location-specific analysis is very sensitive to which facilities are operating. Other warehouse closing scenarios could have major impacts on costs and flows if the warehouses happen to be concentrated in one region.

Scenario 8: Reduced Mid-South Country Storage Rates

Warehouse tariffs vary by region, with the Mid-South tending to have higher monthly storage rates. **Exhibit 66** below presents representative rates (circa 2007) reported at the USDA Outlook Forum[27]. The Realistic Baseline includes similar (warehouse specific) tariffs for receiving, loading, and storage.

Exhibit 66: Representative Regional Cotton Warehouse Tariffs ($/Bale)

	AZ	TX	AR	AL	NC
Receiving		$3.10	$3.35	$2.75	$4.00
Loading	$8.00	$5.00	$10.25	$5.75	$4.00
Compression	$7.25	$9.25	$8.00	$6.00	
One Month's Storage	$3.60	$1.95	$3.25	$2.00	$1.70

Scenario 8 analyzed a type of warehouse restructuring in the form of a reduction in storage rates for Mid-South warehouses. This is termed the “Reduced Mid-South Country Storage Rates” scenario. The need to lower storage rates in country warehouses was an idea that was initially proposed and/or predicted by several industry contacts during the study’s interview process. It is a useful scenario to consider because by lowering storage rates, the issues of compression and rebates (which are rather difficult to explicitly model) are sidestepped. A lower storage rate

[27] Mitchell, John. 2007. “Moving Cotton from Loan to Market in a Post Step 2 Era.” USDA Outlook Forum, Arlington, VA. http://www.usda.gov/oce/forum/2007_Speeches/PDF%20PPT/JMitchell.pdf .

scenario is effectively implied by eliminating compression charges and rebates from the system. Furthermore, a lower storage rate scenario is more consistent with motives for prompt service since there is less of an incentive to hold on to the inventory. This scenario was implemented by lowering Mid-South country warehouse storage rates by 50%. Our prior hypothesis was that lowering Mid-South storage rates, relative to the Realistic Baseline Scenario, would pull more cotton from Mid-South gins to nearby warehouses, as well as increase shipments from country warehouses directly to ports, mills, and intermodal facilities.

Results from the reduced storage rate scenario did produce some expected results **(Exhibit 67)**, but not involving a large number of bales or warehouses. Lowering storage rates had the substantial effect of lowering the aggregate system-wide shipping/handling costs, mostly from reduced storage costs. Transportation costs were also lower due to a small reduction in intermodal flow (mostly from Dallas). Total storage in all quarters dropped about 10,000 bales in Alabama, was unchanged in Missouri, but increased by over 60,000 bales in Mississippi, and by over 250,000 bales in Arkansas and Louisiana. However, none of this extra Mid-South storage was Q4 carryover – it reflected additional bales stored in Q1 through Q3 before being shipped to end uses. This is confirmed by the flow comparisons. The Reduced Storage Scenario shows over 900,000 more bales shipped from the Mid-South directly to port destinations; yet, the intermodal flow from Memphis was basically unchanged. The implication is an increase in direct shipments from Mid-South country warehouses to Gulf and Atlantic ports. An underlying assumption is that even running lots can be pulled from one warehouse. In summary, this analysis provides evidence that lowering Mid-South country warehouse tariffs is beneficial in terms of maintaining or increasing storage in country warehouses (i.e., lessening the need for expensive reconsolidation) and meeting demand. The system-wide benefit is over six dollars per bale **(Exhibit 67)**.

Exhibit 67: Realistic Baseline versus Reduced Mid-South Country Storage Rates

	Per Bale[28] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Total RR Costs	Total Truck Costs	Total Storage Costs
Realistic Baseline	$31.34	$692,746,678	$80,689,650	$164,288,900	$308,814,200
Reduced Mid-South Country Storage Rates	$25.16	$556,204,280	$79,019,490	$163,307,300	$174,967,800
Difference from Baseline	-$6.18	-$136,542,398	-$1,670,160	-$981,600	-$133,846,400

[28] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

Least Cost Modeling Summary

To summarize, **Exhibit 68** shows changes in system-wide shipping, storage, and handling costs from alternative scenarios relative to the Realistic Baseline. While cotton flows do apparently follow economic principles of least cost, their predictability is complicated by many factors. The flows of cotton to and from cotton warehouses, and their underlying economics, are as complex as the transportation system with which they are connected. The effects of changes to existing infrastructure are geographically specific (Scenario 7). Economic adjustments throughout the cotton storage/shipping system influence the outcomes of policy prescriptions such as wholesale lowering of regional storage tariffs (Scenario 8). Scenario 8 did show a possible area of improvement in terms of lowering system costs while maintaining flow. Lastly, the costs of shipping and handling of cotton are highly influenced by external forces. Energy costs are a good example.

Exhibit 68: Cost Comparison of Realistic Baseline with Alternative Scenarios

	Per Bale[29] Shipping and Handling Cost	Aggregate Shipping & Handling Cost	Change in Aggregate S&H Costs from Realistic Baseline
Realistic Baseline	$31.34	$692,746,678	
Scenario 3. Expanded Panama Canal	$31.06	$686,507,576	-$6,239,102
Scenario 5: Diesel at $2.10/gallon	$31.32	$692,252,226	-$494,452
Scenario 5: Diesel at $3.40/gallon	$32.50	$718,260,837	$25,514,159
Scenario 5: Diesel at $4.70/gallon	$33.59	$742,482,227	$49,735,549
Scenario 6. Two Million More Bales East of Texas	$34.95	$772,437,173	$79,690,495
Scenario 7, Fewer Mid-South Country Warehouses	$32.25	$712,869,287	$20,122,609
Scenario 8. Reduced Mid-South Country Storage Rates	$25.16	$556,204,280	-$136,542,398

[29] This is calculated by dividing by the total 2008-09 supply (carry-in and production) of 22.1 million bales.

Chapter 4: Comparison to Other Industries

Merchandizing in the Hardwood Lumber Industry

Hardwood lumber faces many of the same issues as the cotton industry. The nature of the customer base for U.S. forest products has changed dramatically. For example, in 1984 the domestic furniture industry accounted for 65 percent of the demand for U.S. hardwood.[30] Because of the dramatic decline in the U.S. furniture industry, it only accounted for 19 percent of the demand in 2007. Flooring has also faced significant competition from overseas. China went from 5 percent to 33 percent of the U.S. hardwood flooring market between 2001 and 2007. Similar to cotton, a significant portion of the U.S. lumber industry's customer base is moving to Asia.

Domestically produced hardwoods are a complicated product created in various shapes and sizes that are often tailored for very specific uses and applications. Similar to cotton, U.S. hardwoods are sourced from various growing regions across the country with diverse conditions that produce a wide range of specialized end products. Customer needs dictate hardwood production characteristics such as grade, color, texture, moisture content, special lengths and widths, and other milling characteristics[31] (heartwood, burl, gum streaks, mineral streaks, worm holes, bark pocket, decay or rot, wane, split, and pith).

Once trees are selected and cut down, they are transported to a saw mill where the logger will negotiate and agree on a price for the logs upon arrival. This price is known as the gate price. Next, the logs are sorted according to their intended purpose; either veneer or lumber. Only the

[30] Al Schuler, USDA forest service.

[31] North Pacific Hardwood Export, "Hardwood Lumber"

highest quality logs are reserved for veneer. Veneer production can either be done within the sawmill or the logs can be re-sold to veneer mills domestically or overseas.[32]

The hardwood lumber is graded. The lumber is usually graded three times; first while it is still standing, second after it has been cut from the logs and finally again after it has been kiln-dried. The final grade is done in adherence with the National Hardwood Lumber Association (NHLA) grading rules. In most cases, the highest grades of lumber will be selected for export and will often end up as furniture, flooring, joinery and many interior applications, while the middle and lower grades are most often sold in the domestic market and used for numerous furniture and interior applications, as well as railroad ties and pallets.

The hardwood is then dried and sent to a concentration yard where it is prepared for sale. Most often, sawmills have their own separate sales office that deals with the actual sale and distribution of the hardwood products. Sometimes, however, the mill will align itself with a third party supplier or other concentration yard which buys wood from several sawmills and then separately dries, grades, and packages the wood to be sold to distributors.

Lumber mills frequently sell lumber directly to foreign buyers. Most often, the sales are arranged by a foreign agent, but the ownership of the lumber will pass directly from the sawmill to the foreign buyer. A freight forwarder arranges the transportation. When a wholesaler or a distributor acts as an intermediary, these companies take title of the lumber but only for a brief period of time. Ownership by the middleman is very brief.

Hardwood lumber is fungible. If one board meets the same specifications as another board, the two can be interchanged. However, some sawmills may develop a reputation for producing better products although they technically may be of the same specifications of nearby mills.

Applicability to the Cotton Industry

The example of the hardwood lumber industry points to different business models. For example, sawmills often sell directly to foreign buyers, with the transaction facilitated by foreign buying agents. This would be analogous to a cotton gin selling directly to a foreign mill. However, in the U.S. a wide variety of business models have evolved for different industries that facilitate the

[32] American Hardwood Export Council, "Production Process" Accessed at: http://www.ahec.org/

delivery of products from producer to consumer. These various industry models, like cotton's, continually evolve due to changes in commercial as well as political and financial risks.

Grain Industry Transportation

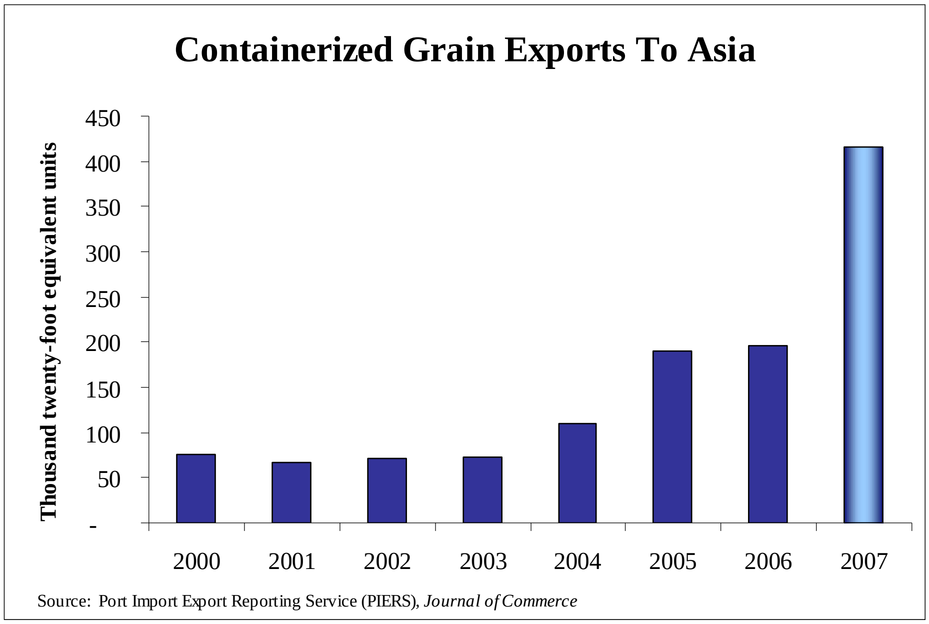
Over the past several years, some within the grain industry have rethought the transportation network that moves grain to market. Traditionally, most grain exports were shipped by a bulk grain transportation network. Whether it is corn, soybeans or similar product, these commodities would usually either travel from the farm to a local country elevator or from the farm to a shuttle train elevator. From the elevator, grain would be transported to the seaport in a covered hopper railcar, which could carry in excess of 100 tons of grain, depending upon the density of the grain type. In traveling from a shuttle train elevator, the grain was shipped in unit train quantities, meaning that the train consists of over 100 cars traveling from a single elevator to a single destination. From a country elevator, railcars traveled in manifest service, in which small blocks or single cars were combined into trains comprised of cars from that elevator, as well as other cars. After the cars arrive at the seaport, grain was transferred to port elevators and loaded onto bulk ships **(Exhibit 69)**. Bulk ships typically carry anywhere from 18,000 metric tons to 220,000 metric tons of grain.

Exhibit 69: Covered Hopper at Elevator and Handymax Bulk Ship

Historically, in the supply chain, grain was treated as a fungible crop (i.e. grain of one type was treated as completely substitutable). When a farmer placed his grain into an elevator, it was mixed with other farmers' grains. When the grain was sold, it was unknown what farm the grain actually came from.

However, in the last several years there was a transformation in how grain was shipped. Instead of shipping all grain in bulk transit, 40-foot long international shipping containers were increasingly used to ship grain. Through 2007 **(Exhibit 70)** and the beginning of 2008, the usage of containers to export grain to Asia increased dramatically.

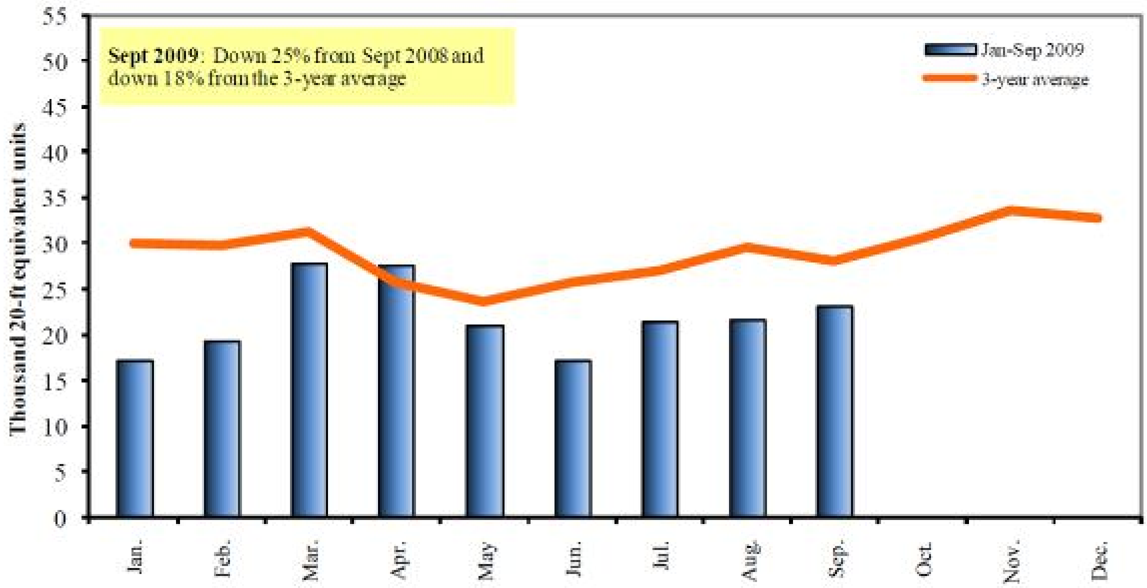
Exhibit 70: Containerized Grain Exports to Asia – 2000 to 2007



Source: U.S. Department of Agriculture

Since that time, exports of containerized grain have fallen significantly, mainly due to a drop in world demand. **Exhibit 71** indicates that 2009 containerized grain shipments have dropped below the prior 3-year average. However, if annualized at 250,000 twenty-foot equivalent units, 2009's total will exceed the 2005 and 2006 averages which indicates that containerized grain export has become a viable transportation mode.

Exhibit 71: Containerized Grain Exports to Asia – First Three Quarters 2009

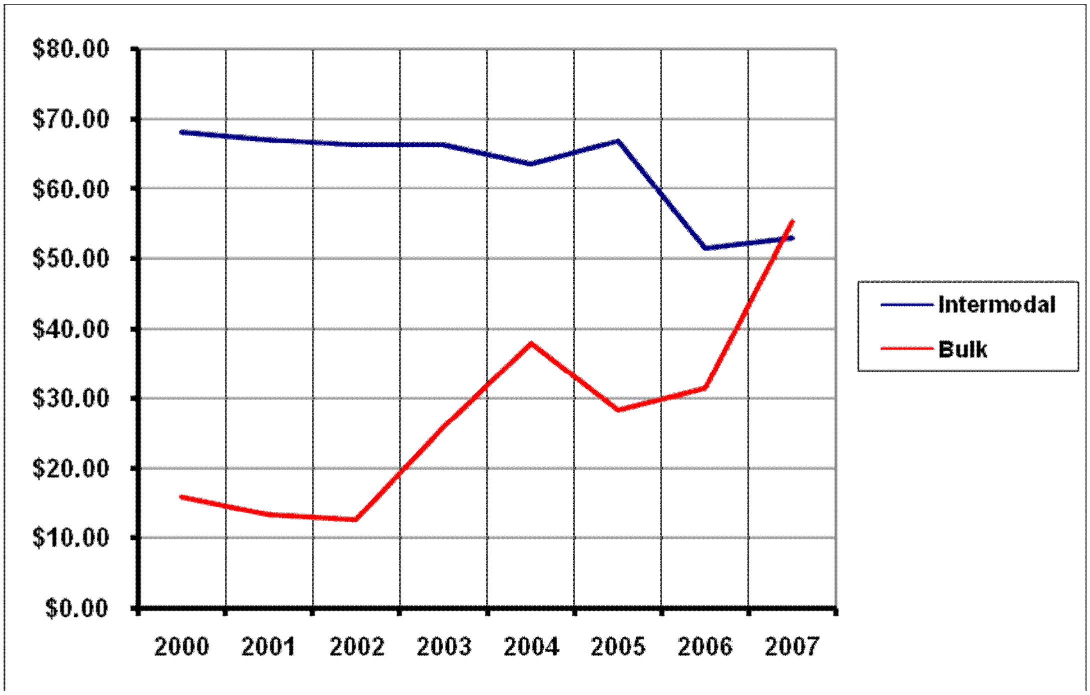


Source: U.S. Department of Agriculture

There were several reasons for the growth of containerized grain between 2000 and 2007. These include the following:

- Growth of identity preserved grains. Due to the increasing importance of organic or non-genetically modified crops, some customers are demanding "identity preserved grains," where the custody of the grains can be traced back to the original source;
- Containerized shipping has become less expensive. As container vessels continue to grow in size, the cost per container continues to shrink. By contrast, the bulk vessel of today is fairly similar to the bulk vessel of a decade ago, with fewer increases in productivity; and
- The relationship between bulk and containerized shipping rates **(Exhibit 72)** changed dramatically for several years due to a high demand for the global bulk shipping fleet. Since that time, the relationship between bulk and containerized shipping rates has reverted closer to historical patterns.
- Shipping lines realigned their fleets in the later years to serve the inter-Asia market and with that the U.S. saw a reduction of bulk ships calling on U.S. ports.

Exhibit 72: Ocean Rates per Short Ton Comparison



Note: Bulk grain rates from PNW to Japan vs. Ocean container tariff rates for soybeans from U.S. to Asia
Source: USDA, WSA Analysis, Assumes 21.75 tons per TEU

As containerized shipping of grain gained popularity, producers of grain clamored for intermodal access. For example, the American Soybean Association & United Soybean Board indicated that, due to drayage costs, "soybean sources in the range of 50 miles around ramps – with single line rail service – would be logical draw area maximums for competitive container freight development." Those shippers with a truck/rail intermodal ramp nearby would be at a competitive advantage. Unfortunately, most truck/rail intermodal ramps are located in large metropolitan areas, far from the primary grain producing locations. In Minnesota for example, intermodal ramps are located in the Minneapolis/St. Paul metro area. However, the top soybean and corn producing counties (Renville and Redwood) are located in the south-central part of the state, hundreds of miles from the Minneapolis/St. Paul metropolitan area.

Both the railroads and shipping companies have been reluctant to provide local intermodal service to remote rural areas. Smaller metropolitan areas have difficulty convincing rail carriers to include their locations within their intermodal networks. For example, the Town of Minot, ND, offered to pay the entire cost of constructing an intermodal terminal there along the rail lines of the BNSF Railway. Local agricultural shippers requested this service. BNSF refused to provide intermodal service at this location. BNSF previously operated an intermodal terminal in Dilworth, MN, just outside of Fargo, ND. This terminal was located in close proximity to some of the largest soybean producing areas in the country. While these soybean producers wanted to export their product by container, BNSF charged a repositioning fee to bring empty containers to

Dilworth for loading. This fee, which needed to be added to the shippers' overall transportation cost, rendered the service uneconomical to most shippers. At one point the governor of North Dakota unsuccessfully became involved with attempts to negotiate lower container repositioning fees at the Dilworth intermodal terminal.

There were several factors that made these rural locations unattractive to carriers for intermodal service. BNSF's own view of the critical success factors for intermodal terminals include the following:

- Service to market that does not overlap with existing intermodal facility;
- Weekly minimum volumes that allow trainload volumes and positive economics;
- Inbound and outbound balance; and
- Sustainable growth over the long term.[33]

The biggest issue with providing service to Dilworth and Minot was criterion number three, inbound and outbound balance. While agricultural areas may provide the opportunity for plenty of outbound containerized traffic, this traffic is not balanced by inbound shipments. Typically, the U.S. intermodal system transports import shipments from Asia, consisting of consumer goods. Large metropolitan areas contain many consumers, and this concentration of population attracts large quantities of consumer goods. After the goods are emptied from the containers, the containers become available for reloading with export goods. Rural areas usually do not attract as much inbound intermodal traffic. For this reason, there are not very many empty containers that can be reloaded. This creates a demand for empty capacity. To supply this capacity, railroads must pull empties from inbound collection points in large metropolitan areas to the rural locations where outbound agricultural traffic is generated. Since there are costs involved to reposition the empty containers, the railroads need to charge a repositioning fee. The repositioning fee to supply empty inbound capacity contributes to higher overall outbound costs.

Applicability to the Cotton Industry

The experiences of the grain industry regarding containerized transportation points are the same for cotton:

- most agricultural commodities are grown and harvested then stored in rural locations that may involve significant transportation to ocean ports and consumers;
- increasingly for grain it is exported by container (cotton made the shift from break bulk shipments to containers several years ago);
- similar to the case for grain, many cotton shippers seek to avoid trucking cotton hundreds of miles to the nearest port and desire to use intermodal to reach the port;
- rail intermodal is usually cheaper than trucking; and

[33] http://www.bnsf.com/markets/intermodal/FOG.html

- to bring intermodal service to rural locations, a number of barriers must be overcome[34]:
  - inbound and outbound traffic must be balanced;
  - rural terminals must be desirable and equitable to serve by transportation partners despite what could be a relative lack of inbound intermodal traffic; and
  - traffic at the terminal must be economically viable.

Comparison to Information Technology Systems Commonly Used in Other Industries

Supply Chain Software

Logically, information technology solutions that would tend to improve the flow of cotton would typically fall under the general category of "supply chain software." This refers to a range of solutions that pertain to transportation, warehousing, planning, and a variety of processes that interact with other business functions within an organization.

In the late 1990s a debate within many corporations revolved around the issue of whether to purchase specialized "best of the breed" supply chain management software or to use the supply chain management offerings of Enterprise Resource Planning (ERP) software applications. ERP systems are integrated applications which can be used to operate a variety of functions within a corporation, ranging from finance to accounting, to operations, marketing, etc. These systems by Oracle, SAP, etc. run many of the day-to-day functions of corporate America. However, supply chain management was considered to be a specialty area, and the supply chain management offerings of the ERP vendors were often considered inferior to those of more specialized companies like i2 Technologies or Manugistics. Companies were faced with the choice of either using specialized software and finding a way to make it communicate with the ERP systems that ran other functions or using the supply chain functions that were provided by the ERP vendors. Since that time, the market share of specialized supply chain software companies have declined, while the ERP vendors have increased their market share. Much of the supply chain software market has been co-opted by ERP software vendors.

It is remarkable just how removed many of these software products and their changes are from the cotton industry. By their nature, the information technology needs of agricultural trades are specialized. As an example, government agencies, such as the U.S. Department of Agriculture often play a fundamental role in agricultural supply chains. While the ability to automate communication with the USDA may be very helpful to an agricultural shipper, this would be

[34] Despite the challenges, a private cotton merchant in Lubbock has been able to successfully operate a modestly equipped terminal on a little over 2 acres that is reported to save him about $12.5 million per year. The empty containers are brought in on double stack cars where they are unloaded and routed to nearby warehouses. Ultimately the loaded cotton containers are shipped largely to Long Beach/Los Angeles port areas.

irrelevant to anyone outside of their industry. The top supply chain management software vendors such as SAP, Oracle, JDA Associates, Ariba (sourcing software), and Manhattan Associates generally do not market specific solutions for agricultural enterprises as they do for a variety of other industries.

Two of the most frequently used supply chain applications across a variety of industries are transportation management (TMS) and warehouse management (WMS). TMS software can provide the following functionality:

- Optimize shipments based on Purchase Order (PO) requirements to meet shipment-windows for deliveries and vessel sailing dates;
- Consolidate orders and optimize shipments from a centralized location or distribution business units;
- Automatically select carriers from prioritized lists based on calculated freight costs, pick-up and delivery performance measures, and claims incidences;
- Track and settle shipment costs, print documents; and
- Use denied-party and embargo lists for international shipping.

The cotton industry's usage of TMS software is not expected to be much different from that of other industries. The cotton industry will tend to have less use for load planning software, since loading uniform bales is a routine activity, and cotton is delivered in truckload quantities with few if any intermediate stops.

Warehouse Management Systems

Warehouse Management Systems (WMS) software controls the movement and storage of materials within a warehouse and processes the associated in and out transactions. Directed picking, replenishment, and directed put-away are key aspects of WMS. Some WMS functions and logic are below:[35]

1. Location sequence. The sequence by which material is put-away or picked can be optimized;
2. Zone logic. A warehouse can be separated into zones, so that certain areas of a warehouse are designated for materials with specific attributes. This must be combined with exact location information;
3. Quantity or unit of measure. This logic directs picking of the same item to specific locations based upon the size of the order. For example, pick quantities of 25 may be located in a special "quick pick" area, separate from an area pick for picking quantities over 25;
4. Fewest locations. Pick or put-away in the fewest locations attempts to improve efficiency by selecting the lowest number of locations, either to fulfill a pick or to put-away;

[35] David Piasecki, "Warehouse Management Systems (WMS)."

5. Pick to clear. This logic directs picking to those locations where the smallest quantities are on hand in an attempt to clear small quantities of items and make better use of space;
6. Nearest location. This logic looks for the nearest location to the last put-away or pick in order to minimize the distance between locations;
7. First-in-first-out (FIFO). Directs picking from the oldest inventory first;
8. Last-in-first-out (LIFO). Directs picking from the most recent inventory first;
9. Task interleaving. Dissimilar tasks such as picking and put-away are combined to improve efficiency;
10. Automated data collection. WMS are combined with automated data collection technology, including barcodes and radio frequency terminals;
11. Integrated with automated material handling equipment. WMS systems can be combined with automated equipment for storage and retrieval;
12. Advanced shipment notifications. Notification is provided of inbound shipments, and this notification is incorporated into warehouse planning;
13. Yard management. Inventory is managed not only in the warehouse, but also in trailers parked outside in the yard, including the empty trailers themselves; and
14. Labor tracking/planning. Assignment of workers to cover inbound and outbound shipments can be preplanned and their productivity can be tracked.

However, the cotton industry has a very narrow range of stock keeping units (SKUs) and does not benefit from a typical WMS's massive data handling capability to manage inventory and pick-lists that can range from 30,000 to 60,000 or more SKUs. Thus, the more elaborate WMSs are over-scaled and perhaps represent too large of an investment for a typical cotton warehouse. Right-sizing of the WMS appears to be the key issue.

A number of factors limit the ability of cotton warehouses to use and take full advantage of the same WMS functionality as would be the case in other industries. Because of the delay in delivering samples and receiving classing data from USDA, cotton warehouses do not know the characteristics of bales until they have already been stored in their warehouses. After classing data has been received, this information is not necessarily retained by the warehouse. With the exception of warehouses owned by merchants and marketing cooperatives, cotton warehouses seldom own or control the inventory that they are storing. Because a bale may be traded multiple times after it arrives at a warehouse, the cotton warehouseman will frequently have little idea who owns the bales within their warehouse. Except during the harvesting/ginning season there is no product replenishment activity at country warehouses, which is not the case for non-agricultural warehouses looking for multiple stock turnovers. The bales are stored after ginning and are shipped in lots throughout the following year.

Despite the efforts of the warehouseman to maintain the integrity of his inventory, he lacks ownership of the bales, and thus is unable to play a role in the selection process (i.e. when, which and where). Bales cannot be substituted for one another. Because of ownership issues, they are not fungible. Even when bales are very close to being identical, the warehouse does not have the ability to substitute bales. As a result, many of the warehouse strategies that most WMS systems facilitate are inapplicable to the cotton industry.

Cotton warehouses also have different information requirements than those usually available in WMS systems in other industries. Most cotton is initially stored and financed using the USDA loan program. Bales placed into the loan program are valued based on their quality characteristics, and the loan must be repaid, taken out of the loan program (redeemed), when bales are eventually delivered/shipped. A loan redemption occurs except when a “loan transfer” occurs which gives shippers the ability to move cotton to other warehouses or when cotton is forfeited to the government. Because cotton bales are accompanied by a formal title of ownership, transactions must facilitate transfer of warehouse receipts. And since the quality characteristics are determined by the USDA, WMS applications used by the cotton industry must be capable of data transfers with the USDA.

Because of the unique limitations and needs of the U.S. cotton industry, it is therefore not surprising that the industry has developed its own set of tools. This section discusses some industry-proposed changes to three of the primary technology tools in the industry: electronic warehouse receipts (EWR), the eCotton WMS system, and the Engineered Fiber Selection (EFS) system. Features of WMS systems used by other industries and their applicability to the cotton industry will also be discussed.

Below is a discussion of WMS features and their applicability to the cotton industry. While this discussion focuses on WMS, the relevance of these technologies is not limited to the warehouse segment of the industry. Many of these technologies, such as EDI and XML are relevant outside of the warehouse segment. WMS was also selected as the primary area of investigation because the process of receiving, storing, assembling shipping orders and shipping cotton out of warehouses is unique to cotton. The trucks that transport cotton and containers that carry cotton overseas are not unique “cotton” containers or trucks, but the warehouses that store cotton are “cotton” warehouses.

An analysis of common features that are expected of most WMS systems in other industries is shown in **Exhibit 73**. These features are compared to what is currently used in the cotton industry, in particular within eCotton warehouse software. In a recent survey by the NCC, about 56 percent of respondents indicated that they use eCotton software, 35 percent indicated that they use their own software, and most of the remainder use another commercial third party software product. The applicability and likely desirability/cost effectiveness of these solutions is also discussed.

Exhibit 73: Basic Functionality Expected of WMS Systems

Feature	Applicability to Cotton Industry
Strong inventory control, including Radio Frequency (RF) and License Plate Number (LPN) schemes.	eCotton allows for hand held equipment, but most cotton warehouses do not use radio frequency. Rather, bar code scanners download by cable. Because this is a batch process, data is not real time. Real time data enables managers to track the assembly of an order. The value to the cotton industry is likely to be less than in other industries where the completion of an order within a given number of hours or minutes is more important. However, the adoption of radio frequency could help flows. LPN is a universal tag standard that is attached to containers. It is an 18 digit data structure with the first series of digits identifying the company and the second set of digits identifying the unique container. It is used worldwide. The system allows for better system-to-system interaction because the LPN should be readable by users worldwide. Any mill could read the number and identify the vendor and unique container. This could benefit the cotton industry.
RF & Paper in the same warehouse, using a zone by zone configuration.	This makes less sense for a cotton warehouse. In other warehouses, RF is used in high volume areas while paper is used in low volume areas. In a country warehouse, the entire warehouse is low volume.
Directed RF tasks that are real time	The availability of real time information could be beneficial for a cotton warehouse, but less important than for a high volume distribution center (DC). It is not as important for a cotton warehouse manager to know at all times the instantaneous status of a receipt, usually they operate by shifts.
Basic inventory allocation methods	Issues such as first-in-first-out (FIFO) or last-in-first-out (LIFO) may not be relevant to all cotton warehouses but are relevant for consolidation, DC and mill warehouses.
Lot control and lot tracking, inbound, outbound serial tracking	These procedures are aimed at providing lot integrity through the supply chain for safety and product recalls if a problem occurs. Because every bale is assigned a PBI number, this integrity is already present within the cotton supply chain. However, it could be worthwhile to consider other elements of cotton lots which could be added, such as seed variety, module or farm designation.
Advanced shipping notice	Information on a shipment is received before shipment arrival in order to reduce the amount of scanning. Cotton warehouses may or may not already receive this type of information through the EWR system.
Web Enabled Customer Inquiry	Customers can log into web enabled software, typically to view inventory availability and outbound order inquiry. Cotton shippers can view their inventory on the EWR system. Several large co-ops and other warehouses permit outbound order inquiry, but this is not universal. Ismyloadready.com allows inquiry into whether bales have been made available for shipment. Increasing the percentage of warehouses that provide this type of information or developing a single source of information for many warehouses could improve flows.
Supply Chain Event Management	This is the ability to send intelligent alerts via email, page, fax, and data file to subscribers to an event. For example, a customer would be automatically notified if an order is ready, if it has been picked up, its journey status, etc. This functionality may be of use to the cotton industry if it can be

Feature	Applicability to Cotton Industry
	implemented as a communication solution that creates a win-win scenario for all cotton interest groups.
Middleware Mapping Software	Middleware enables supply chain management software to communicate with software in other formats. Outside of several accounting software packages, it is uncertain whether eCotton provides this functionality. This could be useful to the cotton industry, although many of the companies are sufficiently small that they may not have need of sophisticated middleware translation tables.
Barcode Label Printing Software	This functionality is available to the cotton industry. Some warehouses use barcode label printing software to replace missing or damaged PBI tags.

Other relevant features of a WMS that may have applicability to the cotton industry are shown in **Exhibit 74**. These features fluctuate within WMS software. Some packages outside the cotton industry may include the functionality, while others do not.

Exhibit 74: Other WMS Features That May Be Relevant to the Cotton Industry

Feature	Applicability to Cotton
Equipment Table	Equipment dimensions are considered when dispatching to various locations in a warehouse, considering whether a specific piece of equipment can negotiate an area of a warehouse. This functionality could benefit the cotton industry in areas such as deciding whether a portable ramp could be located inside or outside a building.
Unique Paths	Most cotton warehouses do not use software that provides warehouse mapping or suggests optimal paths for put-away and picking. WMS software packages of other industries suggest paths, which are often based upon sophisticated algorithms that take into account a detailed mapping of warehouses' layouts. In some cases, the algorithms also consider item weight and size, so that heavier, larger items are picked first. Cotton warehouses may benefit from WMS systems that can improve their pick order. However, it may not be cost effective for cotton warehouses to invest in highly detailed and sophisticated solutions. Within eCotton, pick lists are produced by a report function. Warehouses can structure these reports however they like. However, it may make sense for the industry to develop a set of best practices in terms of generating pick lists.
Automatic Release for Picking of Emergency Orders	The functionality automatically prioritizes expedited/emergency orders. This may be a useful feature for the cotton industry because rush orders do occur, but is contrary to the first order received – first shipped practice that is commonly used in the warehouse segment.
Automatic Grouping & Release to Picking	A series of rules are created to group outbound orders into a pick wave. The picker pulls all of the stock in the wave and then divides per order. Wave picking is used by some cotton warehouses, but generally rules are not included in current software packages. This could be a useful function.

Bin Locator System	The WMS "computer directs" put-away person. Usually, decisions are made based upon warehouse limitations, bin limitations, product attributes or inventory allocation. This type of system appears less applicable to the cotton industry where inventory allocation issues such as first-in-first-out are largely irrelevant, product has consistent properties, and most locations are similar. However, if more information is known about the destination of bales as they are received then better put-away information would be relevant.
Radio Frequency Identity (RFID) Tag Function	The cotton industry does not currently use RFID tags. RFID technology can be considered "cutting edge" or "bleeding edge" technology, depending upon whom you talk to. RFID tags can store far more information and do not need a direct line of sight in contrast to a conventional bar code. In 2004, Wal-Mart mandated usage of RFID tags by its top 100 suppliers. The Department of Defense, Target, and Albertson soon initiated their own pilot programs. Several years later, most suppliers used RFID only if under a mandate, given the high price of the tags and the uncertain return on investment. The cost of the tags has declined significantly with some passive tags costing less than $0.10 per tag. However the cost of implementation is still high, typically between $50,000 to $500,000 plus, just for the computer system and excluding the cost of the tags and hardware.[36] The primary benefits of RFID are as follows: 1) Eliminate shipping and receiving errors. Inbound and outbound shipments pass through a read zone and are compared to advanced shipping notices or to manifests. For outbound orders, if an operator begins to load a bale onto the wrong truck the system can alert the user. 2) Eliminates the need for scanning. The time otherwise spent scanning bar codes is eliminated. 3) Trace. Tags can record all events that occurred to a given bale or lot. 4) Inventory control and accuracy. Readers can point to the specific location of a given tag. Readers can also confirm what has left or entered the warehouse. The study team has not found evidence that issues one through three are particularly problematic to the cotton industry. Issue four could be a significant benefit, but other technologies could also benefit warehouses' ability to locate bales. The cotton industry will want to monitor the status of RFID technology, including the costs of the tags, equipment and implementation.
Labor Productivity Information	WMS track warehousing activities of employees. It is uncertain that the eCotton warehousing software provides this functionality. WMS software that tracks labor productivity would be useful to cotton warehouses and logistics firms.

[36] Maida Napolitano, Contributing Editor, "Warehouse and Distribution Centers: RFID Revisited, *Logistics Management,* February 1, 2010.

Metrics, Key Performance Indicators, Dashboards	eCotton provides report writing capabilities, so that anything within the database can be presented. While the software itself appears to have adequate functionality, it may be best for the industry to develop a set of best practices by which any WMS cotton software could be used to provide performance information.
Score Cards	Some WMS software packages enable companies to capture metrics associated with customers or vendors. This type of feature could be useful to cotton warehouses. It may make sense for the industry to develop a set of best practices using WMS professionals with experience in this area to develop score cards.
Standard XML Transactions	Currently, the EWR and eCotton are based upon batch files, which are typically transferred with EWR's IRIS utility. eCotton warehousing software and the EWR system have been developed based upon XML file formats. According to a representative from EWR, Inc., if a company wanted to use XML for data transfer, eCotton and the EWR system would need to be modified, but this would not be as significant an effort as would be necessary had XML formatting not have already been included within the software. Competition among cotton interests will ultimately dictate if and how XML will be used.
Voice Enablement	Through vocal interaction, employees are told where to go, can confirm or receive confirmation regarding bin locations, item numbers, avoid having to scan barcodes, and confirm quantity sent. Voice enablement allows employees to keep their hands free while still performing warehouse tasks. While this could benefit cotton warehouses, these systems are expensive, and it is unlikely to be cost effective.

As can be seen above, some features of WMS systems in other industries are applicable to the cotton industry while others are not. Many of the more sophisticated features are designed for high volume warehouses that turn their inventory many times per year. The volumes of goods that pass through these facilities may make it easier to justify costly warehouse systems in comparison to cotton warehouses, most of which turn their inventory only once per year.

Transportation Management Systems

About 64 percent of gins interviewed indicated that they arrange transportation from their gins to warehouses. By definition, this traffic is highly seasonal and absent at other times of the year. Because gin to warehouse transportation is highly seasonal, an investment in TMS software does not appear to be justified. For TMS to function, the local carriers would need to be linked to the system to accept order tenders and receive dispatch instructions. Many local carriers do not have the scale or trained personnel to operate the receiving end of a TMS.

Outbound shipments from cotton warehouses tend to be arranged by third parties, freight forwarders or third party logistics providers. It is the third parties that would benefit most from the use of TMS software rather than members of the cotton industry. Many of the larger and more sophisticated freight handling entities already utilize a TMS for cotton and other commodity shipments, so it would be redundant for a warehouse to provide the capability. As discussed above, the primary value that could be provided for the cotton industry would be to provide linkages between cotton WMS and logistics firms' TMS. Ideally, TMS would be integrated between the freight forwarders, shippers, trucking companies, and warehouses.

Decision Support Systems

These supply chain tools help managers to make decisions on a variety of planning horizons, including strategic and tactical decisions. The most common strategic tools are supply chain network design tools. These enable companies to optimize the physical layouts of their supply chain networks by considering tradeoffs between production, warehousing, and transportation costs. Companies can consider the location, number and size of warehouses and distribution centers, the number and location of production facilities, tradeoffs between inbound and outbound transportation costs, and tradeoffs between service and costs. One example of these products is IBM ILOG LogicNet Plus XE software. The most similar product within the cotton industry is the Texas A&M least cost logistics model. However, the Texas A&M model is more oriented toward modeling the cotton industry as a whole while most network design products are focused on specific company supply chains. One issue in using these types of models for the cotton industry is the variability in supply from year to year. Each crop is different, and the supply chain network of one year will be different from the supply chain network of another year.

Other important decision support products are various advanced planning and scheduling systems. These include distribution resource planning systems (DRP) and materials requirements planning (MRP) systems. DRP systems are more applicable to retailers. MRP systems are oriented toward manufacturing. These generally include the following components:

- Master production schedule. Based on actual customer orders as well as demand forecasts, the master production schedule drives the entire MRP system;
- Bill of materials file. This specifies the exact amount of raw materials, components, and subassemblies needed to manufacture or assemble the end product;
- Inventory status file. This file reflects the amount of inventory on hand to fulfill the master production schedule, so that the net requirements can be calculated;
- MRP program. The MRP program calculates net requirements and placed orders for inputs necessary to the production/assembly process; and
- Output and reports. The primary output and reports include information related to: 1) quantities that the company should order and when, 2) any need to expedite or reschedule arrival dates or needed product quantities, 3) cancelled need for product, and 4) MRP system status.

The EFS system appears to perform many of the functions above. The study team is not aware of any significant EFS shortcomings identified by the manufacturing sector in terms of the MRP functions listed above. The issues identified with the EFS system relate less to the MRP functionality and more to the manner in which cotton bales are sourced. In most industries, MRP systems will request quantities and categories of materials required. Because each bale is assigned a unique identifier in the cotton industry (a PBI number), the EFS system goes one step further and actually selects specific bales. This level of precision creates challenges for warehouses implementing their sorting, but provides a great benefit up the supply chain.

Chapter 5: Conclusions Regarding the Status of the Industry

The analyses carried out in chapters one through four shows that the cotton industry is relatively fragmented. This fragmentation is apparent both in the low market concentration in some segments of the industry (reflecting perfect competition), as well as the fragmented nature of the cotton supply chain. Vertical integration across the industry has been limited and usually only extends one level up or down from a segment's core business functions. Moving up or down the core business function chain involves new risks and the unfamiliar nature of those risks appears to be significant reasons behind restricted expansion and vertical integration is not pursued. This limited vertical integration connected with low market concentration implies the margins or risk premiums are tight across the cotton industry.

Industry Concentration

With some notable exceptions, the cotton industry is made up of small to medium sized companies. Several segments have large numbers of industry participants, none of which have a particularly large share of the market. For example, there were 734 active cotton gins in 2008.[37] As of October 23, 2009, there were 401 CCC approved cotton warehouses and thousands of producers growing cotton. The exceptions are the merchants, some of which are subsidiaries of very large corporations, and to a lesser extent the marketing cooperatives and the mills. One cotton merchant is a subsidiary to one of the ten largest corporations in the U.S. and some are tied to large overseas corporations. The merchant sector has been consolidating, and several large companies now control much of the market; however, there are still some small to mid-size merchants across the cotton belt that can be considered relatively significant commercial entities within their respective region.

The largest domestic mill has gross revenues between $500 million and $1 billion. The domestic mill segment has become relatively concentrated but domestic mills still account for 22 percent of U.S. cotton sales. The foreign buyers of U.S. cotton are dispersed, with no one mill or company accounting for a particularly large share of the market.

By comparison, the smallest of the Fortune 1,000 companies had 2008 annual revenues of $1.7 billion. The fragmented nature of the cotton industry increases the importance of the National Cotton Council and other industry organizations, because of the need to coordinate investments in innovative practices to improve cotton flows. For example, Wal-Mart has used its size and market position to dictate supply chain innovations in the retail sector. No one company has the size or scale to exercise the same power within the cotton industry. As a result it may be difficult

[37] USDA NASS.

for individual industry participants to take advantage of the economies of scale necessary to justify investments in innovative supply chain practices or make other long-term investments due to tight cash flows, perceived risks or fluctuations in cotton production.

Fragmentation of Supply Chain

Different entities handle specific pieces of cotton's supply chain. In some instances, incentives are skewed because participants are compensated for performing only one activity within the supply chain without necessarily being penalized for inefficiencies or rewarded for innovations even when practices would benefit the other parts of the supply chain. The exhibit below breaks out the numerous activities performed by industry participants and shows who is impacted even though those other interests do not direct the activities **(Exhibit 75)**. As can be seen from the exhibit below, numerous activities are performed by industry participants that impact others who do not direct these activities.

Exhibit 75: Supply Chain Activity

Activity	Directs the Activity	Impacted by Activity
Shipping modules from Farm to Gin	Farmer	Farmer, Gin, Warehouse, Merchant / Marketing Coop (Shipper)
Shipping from Gin to Warehouse	Gin	Farmer, Gin, Warehouse, Shipper
Slotting cotton in warehouse	Warehouse	Warehouse, Shipper
Buying and selling cotton while bale is in warehouse	Shipper	Farmer, Warehouse, Shipper, Mill Customer
Selection of bales for a purchase order	Shipper, Mill Customer	Warehouse, Shipper, Financial Institutions, USDA, Mill Customer
Assembling (picking, sorting and staging) of order at warehouse for shipping	Warehouse	Warehouse, Shipper, Logistics Firm, Financial Institution, Mill Customer
Picking up orders (load out) at warehouse	Shipper	Warehouse, Shipper, Financial Institution, Logistics Firm, Mill Customer

Uniqueness of Cotton

The uniqueness of the underlying commodity, baled cotton lint, in terms of how merchandising, warehousing, data and transportation systems are integrated is significant. These unique systems make baled cotton difficult to categorize. A cotton bale shares some common aspects with other agricultural commodities, some with other break bulk items such as paper or wood products, but in the end a bale is easily distinguished from other commodities. This uniqueness complicates the development of solutions to cotton supply chain issues as well as the applicability of other industry's solutions to the cotton supply chain. Some aspects that impact its logistics and handling are as follows:

- Like many other agricultural commodities, cotton is harvested during a single short season but sold throughout the year and as a result;
    - Most cotton must be stored for an unknown number of months before it is processed;
    - Majority of the initial storage facilities that house cotton bales will not be replenished after the harvest and ginning season and will turn their inventory only a single time per season;
    - Farmers who do not forward contracted will direct their cotton to gins and warehouses in close proximity for cost reasons and to keep control of their assets;
- Baled cotton is not handled or merchandized in bulk like grain. It is not stored in an elevator, and it is virtually impossible to merchandize and ship baled cotton like a bulk (comingled) commodity;

- Cotton bales are not readily fungible. Each bale carries a unique title. Warehouses typically hold roughly equivalent cotton bales for multiple entities, but the bales cannot be substituted for each other. Cotton cannot be pulled out of storage facilities at random, as is the case with most types of grain;
- Unlike many other agricultural commodities, cotton is extensively classed with high volume, precisely calibrated inspection equipment that gives specific technical measurements, so that each bale is assigned multiple quality characteristics;
- Unlike commodities such as lumber or paper, the quality of cotton varies from year to year by growing area and environment. Because much of the variation is caused by weather, etc., there is little that a producer can do to ensure a more consistent product;
- Unlike raw commodities or field crops, cotton bales are the end product of the harvest that require an additional conversion process prior to merchandizing;
- Cotton has a high value per ton compared to other field crops and requires large amounts of financing through the merchandizing process. For example, while grain exports typically sell at somewhere between $100 to $250 per ton, cotton sells for between $1,000 to $2,000 per ton;
- Cotton has always been and still is a major input into developing countries expansion of their economies through textile manufacturing; and
- Cotton is a cash crop for many small producers around the world. Since it is a non-perishable good and not grown for self-consumption, it can be stored in small lots to be sold when local prices are at an appropriate level or cash is needed.

It is important to recognize that some portions of the cotton supply chain are unique and specific to cotton, while others are not specific if the goal of improving cotton flows is going to be achieved. These variations in the supply chain tend to point to areas where an industry-specific solutions may be required **(Exhibit 76)**.

Exhibit 76: Cotton Supply Chain Improvements

Supply Chain	Specific to Cotton?
Cotton trading network	Yes, although similar to other agricultural trading networks
USDA classing equipment	Yes
Ginning, packing and dimensions	Yes
Transportation equipment to transport cotton from gin to warehouse	No
Cotton Warehouses	Yes (generally)
Trucking equipment to pick up orders from warehouses	No, but the need for the service within a given region can be specific
Intermodal rail service	No, but the need for the service within a given region can be specific
USDA/APHIS inspection services	Yes but USDA tries to standardize procedures across commodities
Cotton Controlling	No
International shipping infrastructure	No
Domestic Mills	No, but limited with their inputs of synthetic fibers
Foreign Mills	No, specifically to U.S. cotton and limited with their inputs of synthetic fibers

Status of U.S. Cotton Merchandising

The perceived priorities for merchandising U.S. cotton depend upon one's perception of cotton and whether it is truly a commodity or a differentiated product. On the one hand, some industry interviewees consider cotton to be a commodity, not too different from other agricultural commodities such as grain. Price is the primary element in selling cotton, and most other considerations are of lesser importance. Like other agricultural commodities the priorities for cotton flow will lie in cost reductions or improving margins. The cost of bringing cotton to market should be minimized.

Grain is an example of how savings have been achieved. The costs of transporting and storing grain have declined due to greater economies of scale. In the mid-twentieth century, exported U.S. grain was stored in relatively small elevators, transported in relatively small railcars on relatively small trains, and shipped overseas via relatively small ships. Now grain is often stored in enormous shuttle elevators which can fill a unit train of over 100 cars, each having the capacity to carry over 100 tons of grain. The large increments by which grain flows through this supply chain defray its cost.

By contrast, cotton is still merchandized and shipped in 500 lb. bales, and the single bale remains the fundamental unit by which cotton is organized, classed, grouped, and transported. Some contend that in order to achieve a reduction in cotton logistics cost, the industry should move away from sorting cotton by 500 lb. bales and instead work with larger increments, or groupings of bales, such as 88 bale case lots or groups of four bales. By grouping bales, the industry can lower the cost of handling bales.

Another perspective holds that cotton is not entirely a commodity. After all, mills go to great pains to sort, inspect, and prepare cotton for spinning. The quality of cotton impacts the speed at which mills can operate. Mills value the detailed classing data that accompanies U.S. cotton. They value the reliability and lack of contamination of U.S. cotton and are willing to pay a premium for this. Shippers value the ability to sort and provide shipments of bales that meet the specific criteria of a customer's order. Under this view, the most valuable contribution of a cotton flow study would be to discover ways that the supply chain could add value to bales and further differentiate U.S. cotton from that of competitors. For example, logistics functions add value to products by making them available at customer locations when and where they want the products. Bale-by-bale classification adds value by allowing mills to buy for very specific needs.

Another approach would be a compromise between bale-by-bale classifications and bale groupings. In this approach, a grouping of bales with individual classing data could be offered and the mill would have access to see the bale data prior to purchase.

Status of U.S. Cotton Data Systems

As mentioned previously, the cotton industry operates in a different data environment from many other parts of the economy. In part, this is because of the unique data needs of the industry as described before. Companies within the industry also tend to be relatively small, so they may have difficulty justifying the enormous expenditure of, for example, an enterprise resource planning (ERP) system. Instead, the industry has developed a series of cotton-specific applications through organizations such as Cotton, Incorporated, EWR, Inc. and others that can be used by members of the industry. In this manner, a single industry-wide series of investments can be shared across a range of organizations. Due to the management of electronic warehouse receipts, the EWR system provides much of the electronic "glue" that links the disparate elements of the cotton industry together.

One area of concern involves data systems integration. It is generally recognized within the field of information technology that the information tools are only as good as the business practices that they support. While the cotton industry has provided information tools to industry members, perhaps it could also provide guidance on business practices that should enhance the usefulness of those tools.

Frequently, when analysts assess supply chains, they consider three different flows across the supply chain: physical flows, information flows, and financial flows **(Exhibit 77)**. Each is important to the smooth functioning of the supply chain. Data systems are generally intended to improve the flow of information, although data systems can also increase the efficiency by which financial transactions flow through the supply chain.

Exhibit 77: Financial Transaction Flows through Supply Chain

Source: Prepared by Wilbur Smith Associates

Stakeholders have identified several information bottlenecks or disconnects within the cotton supply chain:

- Bale classing data is unknown by the warehouse when bales arrive;
- Warehouses often operate in a "data poor" environment regarding the bales status that is stored within their warehouses. For example they often do not know within their warehouse who owns the bales, the values of the bales, when the bales are likely to be shipped and how they are going to be shipped;
- Shippers and the logistics firms are unaware of bale status at warehouses, such as when bales could ship, when they actually are ready to ship, and when they have shipped;
- When shippers and logistics firms place shipping orders, they are unaware of the required effort to fulfill these orders at warehouses, rarely attempt to place orders in a manner that promotes warehouse efficiency and are unaware what level other competitors are shipping; and
- Warehouses may not be aware of whether their methodologies for picking and assembling shipping orders are the most efficient solutions.

Potential solutions for these data systems and communication issues will be discussed later in this technical memorandum.

Cotton Flow Bottlenecks

While the study team was asked to look at the cotton supply chain from bale formation to final end user, the logical place to look for bottlenecks is between the receipt of a customers' order and the final arrival at the customer. A bale's transfer from gin press to warehouse is less relevant to a bottleneck analysis because the timing of the transfer is driven by agricultural seasonality rather than the time constraints imposed by a customer's needs.

What then is the greatest bottleneck which limits U.S. cotton's ability to supply its product when and where customers need it? In general, the steps necessary to bring a bale to the ultimate customer are as follows:

- Order received from a shipper;

- Shipper contacts warehouse to establish a delivery date;
- Shipper may contact a freight forwarder to notify of order;
- Shipper/Freight forwarder arranges ground and /or ocean transportation;
- Shipper/Freight forwarder arranges relevant documents if international shipment;
- Bales are pulled and made available for ground transportation;
- Transportation provider picks up bales for furtherance to warehouse, rail, port, or directly to North American mill;
- If applicable, bales arrive at a warehouse, and all the steps above are repeated;
- If applicable, rail carrier brings bales to port; and
- If applicable, bales are loaded onto a ship and delivered abroad.

Logistics bottlenecks can take one of two primary forms. Either the bottleneck slows the average shipment beyond what would be preferable, or the bottleneck creates a level of uncertainty. Bottlenecks reduce the desirability of the shipper's entire supply chain to the ultimate customer, based upon the extent to which the customer values speedy and reliable deliveries. In the latter case, the shipper and consignee must build the uncertainty into their planning and scheduling through ordering more safety stock which increases their annualized inventory holding cost.

Transit time for shipments to travel from U.S. production markets to overseas customers requires a considerable lead time and can be subject to interruptions **(Exhibit 78)**. For example, to ship cotton from Memphis by Los Angeles normally requires a minimum of 20 days of lead time; this includes six days for the rail journey and 14 days for the ocean segment. Added to this could be a day for a missed cut-off time at a rail terminal due to traffic delays faced by drayage carriers, or a day or two by rail carriers experiencing delays for weather or congestion, or several days at the port if a vessel sailing date is missed. That stated, within tolerance of these unforeseen events, the U.S. intermodal network to the ports is reasonably reliable.

Furthermore, what cotton experiences in transit durations is not much different from the experience of other export-oriented industries. Whether for cotton or other commodities, unavailability of international documentation will delay port departure until all the paperwork is properly processed. Also, foreign customers may be unable to timely secure letters of credit which could delay any type of commodity shipment. For cotton or some other agricultural products, freight forwarders will be required to wait for USDA phytosanitary certificates. However, for the cotton supply chain, the greatest cause of uncertainty and delay appears to be the inability to ship orders within a reasonable time frame. The speed by which warehouses are able to stage, load and ship cotton can vary from several days to more than a month. The pulling of bales from warehouses represents the greatest current long-term impediment to the flow of cotton.

Exhibit 78: Cotton Order Processing

Event	Event Duration	Variation in Event Duration
1) Order received by merchant or co-op	Minimal duration	
2) Merchant contacts warehouse to make bales available for shipment and establish delivery date	Average of five days from NCC survey of warehouses	One to 65 days, based on the pulling efficiency and back log at the warehouse
3) Merchant contacts freight forwarder to notify of order	Minimal duration	
4) Freight forwarder arranges ground transportation	Generally minimal	Can require up to a week if equipment is not readily available
5) Freight forwarder arranges relevant documents for international shipment	Generally no more than several days. Filing requirements are 24 hours prior to loading cargo.	Can require up to a week if the foreign mill is not able to secure a letter of credit. Some shipping lines impose a 36 to 48 hour requirement on documents.
6) Bales pulled and made available for ground transportation	One day	There can be some delay if warehouse has over promised.
7) Transportation provider picks up bales for furtherance to warehouse, rail, port, or directly to U.S. mill	One day	Can be several days if carrier over booked
8) If applicable, warehouse transfers cotton from van to containers and drayage to rail terminal	Moving full blocks of bales to load or unload within 20 to 30 minutes.	One hour to a day or more if an empty container is not available
9) If applicable, rail carrier brings bales to port	Six days	Plus or minus a day
10) If applicable, bales are loaded onto a ship and delivered abroad	14 days	As much as a several weeks if a sailing date/time is missed and another container slot is not available on succeeding vessels.
11) Container must be off-loaded from the vessel and clear foreign customs	One day to several depending on the vessel size	Vessel size, port congestion can add days or weeks.
12) Local delivery to consumer point	Uncertain due to various delivery locations	Coastal regions could be within a day or two, inland destinations could take a week or longer to reach.

Source: Prepared by WSA

Status of Cotton Warehousing and Shipping

As mentioned in a previous working section, the shipping function at cotton warehouses is relatively slow compared to that of other types of warehouses. Generally, a single cotton warehouse crew can assemble a single shipment in a day. By contrast, the typical distribution center can assemble on average the equivalent of five 40 foot containers per person per day. Warehouse activities in other industries tend to fall into three main categories:

- Small item (less than case) operations;
- Carton load warehouse; and
- Pallet load warehouse.

Cotton would be more analogous to the second category, carton load operations. Several reasons have been given for the slow rate of shipping by cotton warehouses:

1. Inefficient orders, which require bales to be pulled from numerous locations;
2. Inefficient storage patterns, such as block stacking which require warehousemen to remove and replace numerous bales in order to pull the desired bale;
3. Low capacity for the shipping function, in terms of people, equipment, and hours that warehouses are open;
4. Poor bale location information, so that picking crews are given only a general sense of where bales are and frequently must hunt for bales within a given location;
5. Low automation, so that pick lists are developed manually with minimal effort at optimizing pick order;
6. Poor communications between the bale disposition holders and the warehouses; and
7. Lack of incentive to correct any of the above.

The cause of cotton warehouses' slow shipping is mixture of the above factors. Regarding reason one, orders could be improved. Bales are more often than not selected without regard to the implications on warehousemen. However, this does not fully explain the situation. Warehousemen in other industries generally do not enjoy the luxury of selecting items located next to each other. In a typical carton load operation, a trailer will be loaded with hundreds of cartons picked from hundreds of locations compared to the typical cotton shipment of 88 bales. In a typical carton load warehouse, warehousemen will need to visit more locations to fill an order than is the case with a cotton warehouse. Yet, the typical carton load warehouse can assemble more orders per person, but note that the carton warehouse operation was able to pull inventory from the front of the racks which is very efficient.

Regarding reason 2, the block storage pattern is highly unusual. Generally, when warehouses in other industries elect to store product in a denser manner and choose to store product on multiple levels, they build racks to store vertically. The cotton warehouse practice of stacking product directly onto one another is rare. Sometimes, when other industry warehouses are located in areas where land is valuable, they may elect for racks that are more than one deep on either side, but usually a system is established to simplify access to the inner racks. The process is not as labor-intensive as breaking down and then rebuilding cotton blocks.

Reason number 3 appears to be an issue as well. Cotton shipping is conducted as a one shift per day operation. Cotton warehouses generally open for shipping between 7:00 and 8:00 a.m. and close by 4:00 p.m. Rarely are additional shifts added to account for peak shipping demand. On the other hand, most warehouses in other industries will turn their inventory multiple times per year. Country cotton warehouses turn their inventory by definition a single time per year. Most cotton warehouses ship low volumes most of the time in accordance with shipping orders. Adding spare capacity to meet peak shipping demand will add cost to the cotton supply chain. That stated, some cotton warehouses appear to demonstrate certain inflexibility in raising or lowering employee expectations and work hours depending upon shipment volumes. Generally, if a warehouse meets the 4.5 percent delivery requirement per week, the warehouse would be emptied in 22 weeks. This implies that a full time, year round warehouse worker would be on hand for 30 weeks a year not producing revenue from filling orders. Obviously, time would be consumed taking in, sorting and stacking bales as well as other routine tasks, but a portion of the 30 weeks would represent under utilization of labor. In addition, if warehouse labor was to be utilized during extended delivery hours, over-time pay would be required for warehouse workers and supervisors, and workman's compensation would increase as would liability insurance coverage.

Reason 4 is more likely to be an issue with warehouses that use block stacking. As blocks are reduced and change shape, it becomes more difficult to maintain an exact location code for that bale. In a recent NCC survey of warehouses, most warehouses indicated that bales are not moved until shipped. However, the definition of a "location" could still be somewhat general, referring to a range of potential row, column, and height within a block. For those bales that are moved, only about 47 percent of the respondents in the NCC survey indicated that they update bale location information when bales are moved.

The evidence regarding reason 5 is mixed. The eCotton software used by most cotton warehousemen does not include optimization algorithms for finding the most efficient pick order. On the other hand, warehousers do attempt to make their order picking efficient. In the NCC survey, 65 percent of respondents divide manifest/pick lists by building or shed. Forty four percent of respondents work manifest/pick lists for multiple orders at the same time. However, there is little evidence of technical systematic approaches to identify the shortest travel time routes, analysis of metrics, or establishment of efficiently sized zones per picker. It is important to keep in mind that order picking in any warehouse, including cotton warehouses, accounts for 50 percent or more of the operating costs associated with the warehouse.

Reason 6 appears to be a matter of instilling good communication tools ranging from a simple phone call to linked electronic messaging. If shippers used location codes, placed early order instructions, held to the composition of an order after it was placed, or at least provided ample early warning if orders faced pending changes to coordinate warehouse operations, warehouse efficiency could be improved.

As discussed elsewhere in the Cotton Flow Study, reason 7, the lack of incentives to improve warehouse picking and shipping operations continues to be an important issue.

Other reasons

Another issue faced by cotton warehouses relates to the layout of these warehouses. Whereas warehouses in other industries will typically consist of a single large building, most cotton warehouses consist of a series of smaller structures due to fire code requirements. In the NCC warehouse flow survey, the median number of buildings actively used to store cotton was nine. The need to enter multiple buildings to fill a single order significantly reduces the efficiency of cotton warehouses.

Status of Cotton Transportation

Generally, transportation assets used to transport cotton bales are not specific or unique to the industry. During the interview and survey process for this study, many of the respondents expressed general satisfaction with the transportation service they receive, as well as the infrastructure. Generally, when asked to rate transportation service, respondents provided high marks. However, this does not mean that cotton does not experience many of the same transportation issues as other agricultural commodities. Several follow:

1. Container availability. Because the U.S. imports more than it exports, the export of agricultural commodities, particularly to Asia is considered a backhaul move. In a sense, this is favorable to cotton, since westbound shipping rates to Asia are lower than eastbound shipping rates from Asia. On the other hand, containers are owned by steamship lines, and these companies have an incentive to reposition containers for the more profitable eastbound move from Asia as quickly as possible. Furthermore, containerships are typically designed to carry containers of consumer products, with 12 to 14 tons lading weight each. By contrast, agricultural products loaded into containers typically weight closer to 22 tons. Therefore, not all containers returning to Asia can be loaded with agricultural products. These issues sometimes make it difficult for U.S. exporters to find available containers.
2. Intermodal rail availability. On average, shipping intermodal containers by rail is cheaper than shipping by truck for distances over 600 miles (closer to 300 miles in the East). Unfortunately, intermodal ramps tend to be located in large metropolitan areas, distant from where much of the cotton in the U.S. is produced. Long drays to distant intermodal ramps add significant cost to cotton exports. In order for intermodal ramps to be developed or retained closer to cotton production regions, several obstacles must be overcome: a) low volume intermodal ramps have poor economies of scale and can be difficult to justify from the rail carriers' point of view, b) containers must be repositioned to intermodal ramps that generate more outbound than inbound traffic, and c) ocean carriers are sometimes reluctant to release containers to small intermodal ramps in remote

areas. Findings from the Texas A&M Least Cost Model suggest that the existence of even small intermodal ramps located in close proximity to production areas can have major impacts on transportation costs. These impacts are particularly important in times of higher fuel prices, where the cost difference between truck and rail tends to be high, given trucking's proportionately higher usage of fuel

3. Securing Trucking Equipment. It is sometimes difficult to secure trucking equipment in a timely manner in remote cotton-producing areas. Findings of the Texas A&M Least Cost Model suggest that in general, proximity to transportation hubs is very important to the cotton industry. Similar to other agricultural commodities such as grain, production in remote areas tends to carry a discount due to the transportation premium associated with bringing this production to market.
4. Truck size and weight issues. It would be most cost-effective from a shipping standpoint to load containers into high-cube containers, but this would put trucks over federal weight limits.
5. Trucking congestion. This issue depends on the availability of drivers and equipment, hours of service regulations, the routes on which the trucks can travel, local jurisdiction restrictions, and exemptions allowed.
6. Port congestion. The dock labor issues and drayage driver slow-downs have in the past added days or weeks to shipping times. In some cases shipments had to be diverted to another mode, routed through alternate rail connections, or directed to a different port in an attempt to satisfy a delivery schedule.
7. Infrastructure Improvements Various improvements to shipping infrastructure, such as the development of the Port of Prince Rupert, improvements to the Panama and Suez Canals, could create new opportunities for shipping cotton. For example, findings from the Texas A&M Least Cost Model suggest that the expansion of the Panama Canal and a potential shift of trans-Pacific trade to East Coast ports could result in significant savings to the cotton industry. Findings of the model suggest that total cost reduction of $6.2 million dollars could acrue from shifting trans-Pacific trade to East Coast Ports.

8. Cotton Network Rationalization. There is a view by some within the cotton industry that the cotton supply chain network needs to be rationalized. Cotton stored in non-strategic locations in country warehouses has a less direct route to market. A cotton network rationalization would be analogous to a shift that has occurred within the grain industry **(Exhibit 79)**. Formerly, grain was stored in small country elevators, which were served by short line or regional railroads using carload rail service. Increasingly, grain producers bypassed small dispersed country elevators and instead concentrated their storage in large shuttle elevators where they could enjoy economies of scale. These shuttle elevators are much larger than country elevators and ship grain in train-load quantities of over 60 cars. The rationalization of the cotton supply chain would be analogous, so that cotton's small country warehouses would be shuttered in favor of larger regional warehouses.

Exhibit 79: Country Grain Elevator Logistics Model

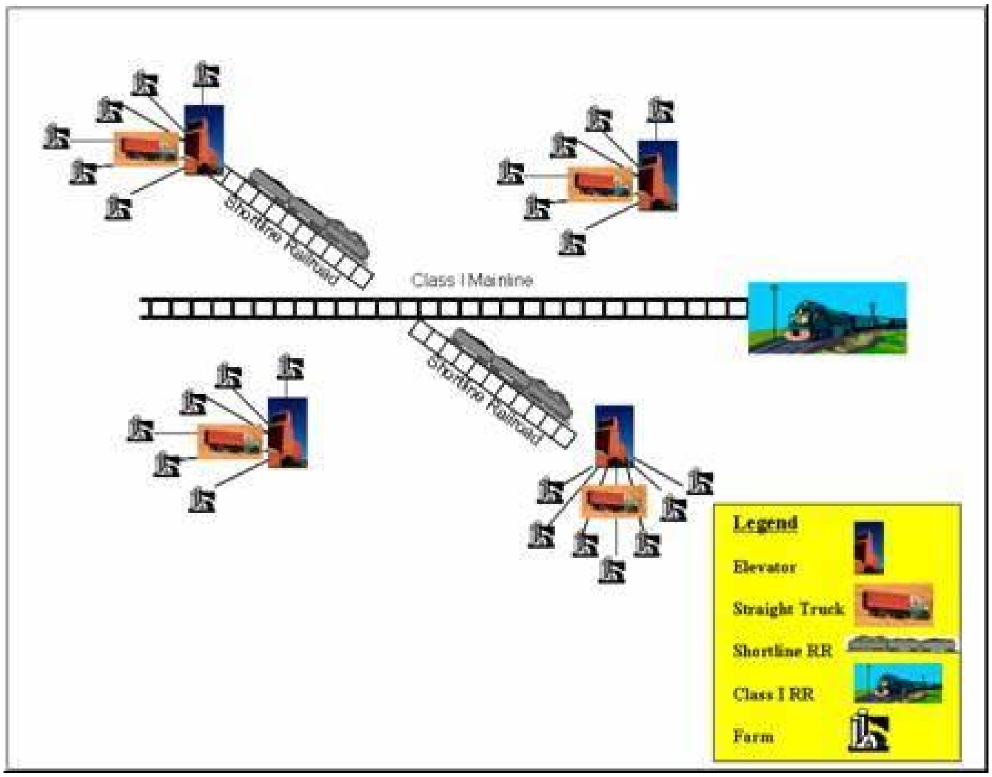
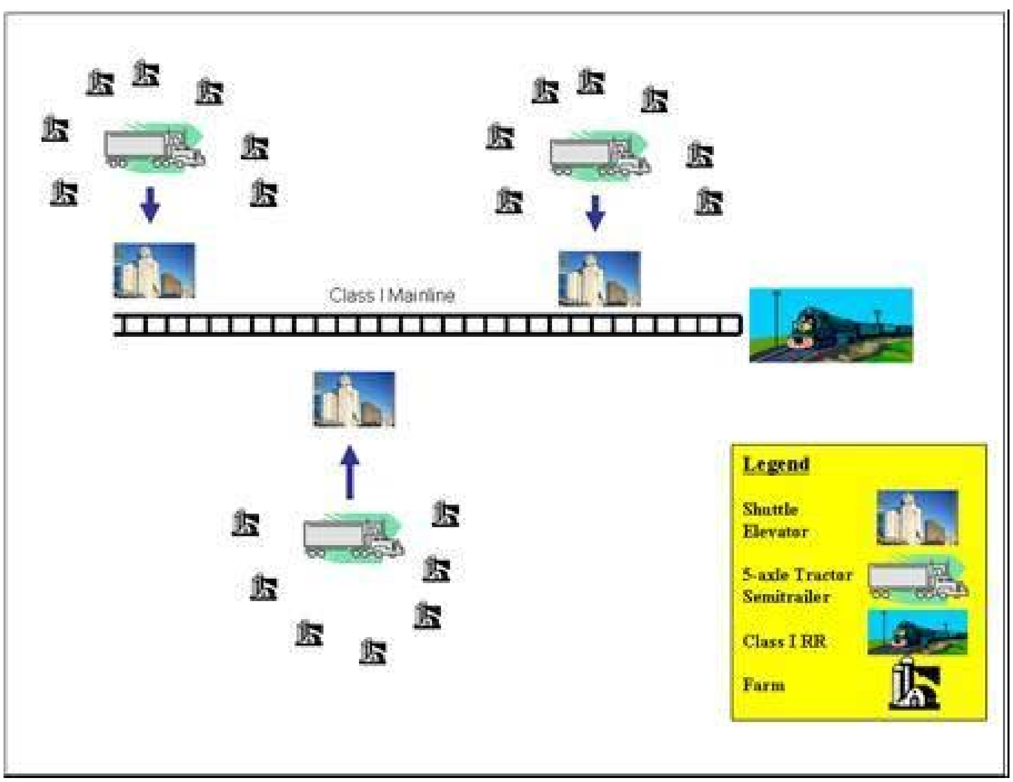


Exhibit 80: Shuttle Train Grain Elevator Logistics Model



The findings of the Texas A&M Least Cost Model suggest that the elimination of country warehouses by themselves would not improve cotton flows or reduce costs. In fact, even if the most expensive warehouses were eliminated, closing country warehouses would actually increase costs to the cotton supply chain by adding transportation costs. However, this analysis does not consider other factors, such as the relative service levels, economies of scale, or the extent to which transportation rates could change as a result of consolidating warehouse operations. It is likely that any "rationalization" of cotton warehouse capacity would need to be coupled with transportation savings. In the case of grain, the shift to shuttle elevators is the result of superior rail unit train service. Carload rail service is relatively more expensive, and frequently requires cycle times of multiple weeks. By contrast, unit trains are cheaper on a per ton basis and unit train sets are typically loaded, delivered, returned empty within a matter of days rather than weeks. An analogous "rationalization" within the cotton industry would also need to derive a volume-based discount or improvement in transportation service.

Chapter 6: Recommendations

Whereas earlier sections of this technical memorandum discuss the research, analysis, and findings reached in the Cotton Flow Study, this section explores the practical implications of the findings and presents recommendations to the industry. This section categorizes recommendations into four groups:

- Merchandising;
- Data systems;
- Warehousing and shipping; and
- Transportation.

In a number of cases, the recommendations for each group could fall into multiple categories. Recommendations are also categorized as "industry supplied" and "study team recommendations." The industry supplied recommendations are the hypotheses that were supplied by the Vision 21 Cotton Flow Study Committee following the meeting on September 29, 2009. The study team recommendations were those that have been independently developed.

Each hypothesis has been analyzed in light of industry feedback and an analysis of cotton industry data. Each has been assessed with regard to its impact on cotton flows and ease of implementation. The impact on the cotton flows is rated on a score from 1 to 5 with 1=low impact on the cotton flows and 5=high impact on cotton flows. The ease of implementation was scored as 1=difficult to implement and 5=easy to implement. The purpose of the grading was to identify which hypotheses should be a priority for the industry, which would be worth pursuing but lower priority, and which are not worth pursuing. The grading was also intended to distinguish between short-term and long-term initiatives. Generally, short-term initiatives are relatively easy to implement but probably not as high value to flow, whereas long-term initiatives are those that have higher value but that may be more costly or difficult to implement. Some hypotheses were measured in quantitative terms. Where applicable, net benefits to cotton flows considered the following:

1. The percentage of bales marketed in a given year to which the flow recommendation would apply;
2. The dollar savings per bale that the recommendation would bring; and
3. The dollar costs that the recommendation would cause.

Where applicable the ease of implementation rating considered the following:

1. The dollar cost of implementing the recommendation;
2. Likely industry opposition to the recommendation; and
3. Likely industry inertia, i.e. misalignment of incentives to the recommendation.

In most cases, information is not available that would allow for a full monetary evaluation of the initiative, such as a cost/benefit or a net present value assessment. However, the additional quantitative information will provide objective data points by which the hypotheses can be evaluated.

Recommendations Regarding Merchandising

Exhibit 81 is a summary of issues that have been identified in the study, proposed solutions, and solutions preferred by the study team.

Exhibit 81: Merchandising Issues and Proposed and Preferred Solutions

Issue	Proposed Solution(s)	Preferred Solution
Short-term contracts and spot purchases make supply chain planning difficult and cause uneven cotton flow	Try to encourage buyers, particularly foreign mills to purchase cotton using longer term contracts.	-Encourage usage of programs that promote longer term contracts -Work with CCI to educate buying teams on best practices on contracting and buying U.S. cotton.
Marketing cotton by the individual bale causes inefficiencies for a range of warehouse functions, as well as marketing functions.	- Initiate trading units of short ton (ST) or four bale clamp loads - Initiate trading units of 88 bales or container loads - Market bales by quality groups rather than by each fiber characteristic gradation	-Develop a pilot program to investigate the feasibility of establishing ST units -Encourage the establishment of alternate cotton supply chains, whereby some cotton would be marketed by the container load with a reduced basis, reflecting lower warehouse charges.
Classing cotton at USDA classing offices is a hindrance for bale sorting upon arrival at the warehouse, since lint characteristics are unknown until after cotton has been slotted in a warehouse	Perform classing at the gin	Investigate further the likely impacts on classing costs as compared to the current system. If economics appear reasonable, initiate a pilot program.
The APHIS phytosanitary is an inspection "requirement" by country of destination and differs by country. The process is not fully electronic and adds cost to the supply chain.	- Automatically perform inspections on all bales, regardless of destination at all warehouse that have a National Cotton Compliance Agreement. - Create a standard, electronic phytosanitary certificate through the provider system.	Work with APHIS to ensure that cotton is allowed to use electronic form 572 (pre-shipment inspection) and publish a list of warehouses with National Cotton Compliance Agreements

	- Work with importing countries on specific phytosanitary requirements.	
Heavy reliance of the cotton industry on middle men can create an information barrier between those who produce cotton bales and the ultimate consumers.	- Improve communications through CCI and CI activities - Encourage direct interaction between foreign buyer's agents and cotton producers/gins - Create an information channel to share international mill requirements with U.S. producers - Work with the USDA to make their data more user friendly in the international markets	Encourage direct interaction between foreign buyers and their agents and cotton producers/gins.

Industry Supplied Recommendations for Merchandizing

Merchandizing 1: Longer buying and selling strategies

Hypothesis: Initiate longer buying and selling strategies by better use of the futures market and on-call contracts, which should even out flow patterns.

The preliminary observations of Technical Memorandum #1 suggested that there was little inclination or ability to coordinate an initiative to influence buyers' behavior and purchasing mechanisms. It is likely that market forces will have more impact on a buyer's usage of futures markets and on-call contracts than a NCC initiative. The factors that could tend to increase the usage of longer-term, on-call contracts would include:

- Longer-term relationships between U.S. merchants and foreign mills;
- A "bull market" for cotton, which will increase the risk of not locking into a longer-term contract;
- Changes to the manner in which yarn is purchased from foreign yarn mills. Many yarn mills cannot enter long-term contracts for U.S. cotton because their own customers are buying their yarn on a spot basis;
- Fading memories of the 2003 and 2008 season market volatility; and
- Successfully and effectively addressing the underlying issues that caused the giration in the ICE cotton futures market.

That said, investigating ways to influence buyer behavior, particularly of foreign mills which tend to rely heavily on short-term spot or one to two month contracts, has merit. One approach could be an expanded use of an export credit guarantee program. The U.S. Department of

Agriculture already maintains the GSM-102 program. This working paper recommends the following policy statement:

"The National Cotton Council should investigate ways to expand and enhance the usage of GSM-102 like programs in order to promote the usage of longer term, multi-delivery contracts by foreign buyers of U.S. cotton."

Merchandizing 1	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	3
Updated Rating	2	3

Priority: Medium/Low
Time frame: Short term

Merchandizing 2: New trading unit – 4 bale clamp unit

Hypothesis: Initiating new trading units could improve the handling of bales: A short ton (ST) or four bale clamp load or one ton of cotton

Percentage of Market Impacted – Theoretically, the market for the ST would consist of those mills that are willing to buy in four bale increments and/or those merchants willing to buy/sell four bale case lots. Unfortunately, this is impossible to quantify because four bale case lots are currently not being used. Furthermore, the adoption of this practice would likely depend upon how it is implemented. It would be preferable to make the purchase of a case lot the equivalent of buying a single, one ton bale of cotton. The quality characteristics of each bale would be very similar. Preferably, each bale would be taken from the same module and included in the same module quality averaging as is performed on single bales. It is likely that the initial adoption of the ST would be slow, but then would expand if it is found to be successful and STs were found to save costs.

Benefit per Bale – The implementation of the ST could have significant savings to warehouse operators. If the four bales are kept together, warehouses would pick in one ton increments instead of one quarter ton increments. Based on conversations with warehouse operators, locating and picking cotton from multiple locations accounts for the majority of costs in filling orders. If all bales within a shippable lot were in the same location, assembling an order of cotton would be easier. Most warehouses arrange cotton by bale number. If the typical merchant were to request all bales in all shipping orders in order of bale number, the adoption of STs would not save any money. All bales would be taken from a single location whether in a ST or individual bale. On the other hand, if the typical shipping order for 88 bales were to be picked from 88 locations, the adoption of STs could potentially reduce costs to almost a quarter, since the equivalent shipment of 22 STs would now be picked from only 22 locations. No definitive study has been conducted regarding the number of locations from which a typical cotton shipping order is picked. NCC supplied several analyses of shipping orders. The number of locations from which bales were picked varied widely. On several shipping orders, almost none of the bales selected were sequential, and all 88 bales were selected from 88 different locations. These were purchase orders made using the Engineered Fiber Selection (EFS) system. On other shipping orders, the number of locations from which bales were selected varied between 18 and 41. If the typical shipping order were to require that bales be pulled from about 40 locations, which could be reduced to 22 locations were STs adopted, then the cost savings would be roughly 45 percent.

NCC's staff recently conducted a study of warehouses referred to as the Cotton Warehouse Flow Survey. This survey found that the typical cotton warehouse will assemble a single order per team per day. Some picking teams consist of a single employee, while others consist of multiple employees. The overall median number of bales picked per employee per day from the survey was 60 bales per eight hour shift.[38] Data from the USDA as well as Payscale.com suggest that the typical warehouse employee is paid somewhere in the range of $12 per hour. Data from the U.S. Bureau of Labor Statistics suggest that 30 percent is a reasonable estimate for a fringe benefit rate, so the typical warehouse employee would be expected to receive total compensation somewhere in the neighborhood of $15.60 per hour or $124.80 per eight hour day. Data from a survey by Phil Kenkel of Oklahoma State University of members of the Cotton Growers Warehouse Association (CGWA), suggest that the incremental cost of lift trucks (repair and fuel) is roughly $27 per day. Therefore, the daily cost of an employee and associated lift truck is $149.80. Divided by 60 bales, this comes to $2.50 per bale. If a ST were to reduce the cost of picking bales by 45 percent, the savings would be roughly $1.14 per bale.

Costs per Bale – The costs associated with STs would result from the additional handling necessary to keep the four bale clamp load together throughout the supply chain. This would include the cost of preparing identifying numbers or marks, perhaps a slightly slower speed for moving the bales, as workers check to make sure that each ST is properly assembled. These ongoing costs would be expected to be minor. It also is uncertain whether there would be any lost or gained sales as a result of the initiative.

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[38] Compared to warehouses in other industries, this rate of shipping is extremely low. As an example, Georgia Southern University and Supply Chain Visions prepared an annual warehouse metrics survey of 1,000 managers of distribution centers (DC). The study found that in the average DC, the typical number of pallets shipped per hour per employee is 13, or 104 per eight hour shift. A 40-foot international container can hold 20 pallets, so the number of containers that could be shipped per employee per day is 5.2. This compares to a cotton warehouse performance of 60 bales picked per employee divided by 88 bales per container equals 0.68 containers per day per employee. A typical distribution center can fill over 7 times as many containers per employee on a given day as a cotton warehouse. The turnaround time from order receipt to deliver is usually 24 hours or less. *http://www.dcvelocity.com/articles/20100329metrics_survey/*. Obviously, the number of bales picked per day will vary by stacking pattern, with block stacking being the more labor-intensive from which to pick. The NCC study included warehouses with a range of stacking.

Cost of Implementation – If the concept of a ST were to be broadly used, it would need to be integrated into the associated information systems. Warehouse software must be modified to account for STs as would the EFS suite of programs. These changes would require some effort and coordination by all involved.

Likely Industry Opposition – Several members of the Vision 21 Cotton Flow Committee were unenthusiastic about this idea. There would likely be some significant opposition.

Likely Industry Inertia – Merchants would need to have an incentive to trade in ST lots. Otherwise, they probably would not bother.

Conclusion – The concept of a ST could have potential to improve the flow of cotton. Adopting the practice industry-wide would require an extensive change in mindset, but not necessarily the systems that serve the industry. Perhaps, pilot programs could be warranted to test the concept.

Merchandizing 2	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	4	2
Updated Rating	3	2

Priority: Medium/Low
Time frame: Long term

Merchandizing 3: New trading unit – 88 bale container loads

Hypothesis: Initiating new trading units could improve the handling of bales: Mark/container load of 85 to 88 bales depending on weight

Percentage of Market Impacted – The MARK need not consist of bales of identical quality characteristics. Bales would be grouped into marketable lots of similar but not necessarily identical quality characteristics. This is already done in some instances and there is no barrier to presorting MARKs now. It is a "push" logistics strategy where orders are preassembled in anticipation of a sale in contrast to the usual cotton "pull" logistics strategy whereby bales are sorted in response to a purchase order. The central question is why cotton is not sold more often now in preassembled lots.

Push inventory systems inherently entail greater risk than pull inventory systems. By presorting bales, one is assuming that someone will want to buy that 88 bale lot. In some cases, this may be a viable assumption. A grower or a gin may be familiar with a given buyer's requirements and could group bales into these tightened characteristic ranges for marketing. However, requirements can change, and there will be mismatches between what mills are demanding and the parameters of a given MARK. The key to successfully working with MARKs will be to ensure the bales fall within reliably tight quality ranges. If the shippers can communicate directly with the mill, the mill's required parameters are steady and the cotton coming out of the gin or warehouse happens to meet those parameters, then the MARK will be the efficient solution.

The consulting team talked to one merchant who mentioned that MARKs are a more viable solution for mills that have more sophisticated machinery. Mills with better technology can produce the same product from a broader array of cotton fibers. Chinese mills require a narrower band of fiber characteristics because the technology tends to be less advanced and more inflexible. As overall technology improves, the marketing of MARKs could be expanded. However, the marketing of "recaps", or various mixed bales with a broad array of qualities that a merchant offers for sale, would tend to benefit mills that do more of the sorting themselves. Currently, Turkish mills are more likely to buy "recaps".

Benefit per Bale – If a MARK is assembled directly out of the gin and placed into the warehouse as a preassembled lot, it could eliminate most of the incremental cost associated with assembling a shipping order. A process that had taken all day can now be shipped in about a half an hour. This would translate to a savings per bale of $2.34. The MARK could also promote additional sales, since it can be shipped much more quickly than a shipping order that must be assembled. These incremental sales are impossible to quantify at this time.

Costs per Bale – If the MARK is assembled straight out of the gin, there is no additional cost of assembling a MARK. If the bales have already been stored in the warehouse, the cost of assembling a MARK would be similar to that of assembling a shipping order, $2.50 per bale. The additional risk of trying to sell a MARK would also generate cost. If the MARK cannot be sold, bales must be found and selected from within the MARK to fulfill other shipping orders.

Cost of Implementation – The cost of implementation is minor. Mostly, it consists of gaining market intelligence to understand who would buy a pre-assembled lot of cotton. However, to be most effective, the MARK system should be used in conjunction with advanced fiber measurement systems at the gin, such as by USTER Technology's INTELLIGIN, which would significantly add to the cost of implementation. This would enable MARKs to be assembled from the gin.

Likely Industry Opposition – Mills and merchants could elect to use or not use the MARK as they see fit. Opposition would not be expected to be too strenuous.

Likely Industry Inertia – Many U.S. merchants believe that the ability to assemble shipping orders at customers' requests is a strategic advantage. Several merchants have said that they would be happy to buy presorted container loads, but that they would pay a discount for them.

Conclusion – There is little objection to presorting cotton into marketable container loads. This practice could enable warehouses to assemble and ship over a dozen loads per day compared to a single load, as is the practice at most warehouses. However, the demand for bales marketed in MARK quantities appears to be limited or at least in the early stages of adoption. Turkish mills are willing to buy in MARK quantities, but this represents only about 14 percent of the export market. Some of the Chinese purchases are in MARK quantities, but an increase in utilization would improve the efficiency of the system. Unless other buyers are interested in MARKs, overall impact on cotton flows will be minor.

Merchandizing 3	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	3
Updated Rating	2	3

Priority: Medium/Low
Time frame: Short term

Merchandizing 4: New trading unit – larger bales

Hypothesis: Initiating new trading units could improve the handling of bales: larger bales

This hypothesis was not originally supplied to the study team by the Cotton Flow Study Committee at the committee's meeting on September 29, 2009. Rather, the idea was presented to the study team and evolved through subsequent interaction with industry participants.

Conclusion – This idea may have long-term potential but is currently contrary to National Cotton Council policy. The dimension of the U.S. bale is the International Organization for Standardization (ISO) standard.

Merchandizing 5: Industry standard APHIS documentation

Hypothesis: Set an industry standard on export shipments that improve the Animal and Plant Health Inspection Services (APHIS) documentation

The APHIS web based Phytosanitary Certificate Issuance and Tracking (PCIT) System has been available for several years but has limitations when compatibility with cotton business practices come into play. With the PCIT system firmly in place, the cotton industry has worked with APHIS to insure that warehouses with "National Cotton Compliance Agreements" (NCCAS) may continue to inspect densely packed baled cotton for exporters. This includes making sure exporters can obtain a paper APHIS form 572, a document stating that the necessary pre-shipment inspection has been performed, so that an exporter has the necessary documentation to apply for and receive a properly issued APHIS 577 (phytosanitary certificate or "phyto").

Commodities such as grain are considered high risk commodities when it comes to phytosanitary concerns and have extensive pre-shipment inspection programs (i.e. FGIS) in place to provide the needed services. Some commodities do not have sufficient infrastructure to support a commodity specific pre-shipment inspection program so they rely on state accredited inspectors or APHIS agents to perform their inspections for them. However, in the case of cotton, APHIS has accepted cotton industry research data that demonstrates that densely packed baled cotton is a low risk when phytosanitary issues are raised.

Because phyto documents are government to government, not business to business, there are still some obstacles to be negotiated with some of our trading partners before electronic phyto issuance is the norm. In the meantime the NCC and others should work with APHIS to make sure the PCIT System is cotton-friendly. This paper proposes the following policy statement:

"National Cotton Council staff should work with APHIS to ensure that cotton is allowed to use electronic form 572 (pre-shipment inspection), encourage all warehouses to initiate the 572 form when the EWR receipts are released, and publish a list of warehouses with National Cotton Compliance Agreements."

Merchandizing 5	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	3	4
Updated Rating	3	4

Priority: Medium/high
Time frame: Short term

Merchandizing 6: Better use of gin classification data

Hypothesis: Usage of gin classification data

The original hypothesis provided through the Cotton Flow Study Committee suggested the following: "*Measure and determine bale's relevant quality characteristics at the gin. These gin measured quality parameters would be used for marketing, storing, shipping and processing when EFS or similar lay-down systems are used.*" The study team felt that it would be preferable to clarify this hypothesis and to create three scenarios:

- Gin classification data is used to group cotton into similar categories without confirmation from the USDA
- Gin classification data is used to group cotton into similar categories with confirmation from the USDA
- USDA classification is performed at the gin (technology is still under development)

Under these three scenarios, the potential usage of gin classification data can be better explored and evaluated.

Merchandizing 6a: Group by classification data – without USDA confirmation

Hypothesis: Use gin classification data to group cotton into similar categories without confirmation from the USDA

Conclusion: The detailed independent USDA classing data that accompanies U.S. cotton bales represents a key differentiating factor for U.S. cotton. Without consistent, reliable classing of bales, U.S. cotton would likely lose a key strategic advantage. The study team recommends that the industry not pursue this hypothesis, at this time.

Merchandizing 6a	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	2
Updated Rating	2	2

Priority: Recommend not pursuing at this time

Merchandizing 6b: Group by classification data – with USDA confirmation

Hypothesis: Use gin classification data to group cotton into similar categories with confirmation from the USDA

Percentage of the Market Impacted - Gin classification data would eliminate the usual lag between bale storage in warehouses and the receipt of USDA classification data. Logically, one would think that cotton flow would be improved if warehouses could know what they were storing before they stored it. However, a number of respondents told the consulting team that this information would not be useful for the following reasons:

- Warehouses receive too many bales in too short of a time during ginning season to feasibly spend the time to organize bales by class;
- Bales are not pulled from warehouses based upon quality, or at least a quality rating system by which the warehouse could store cotton; and
- Warehouses are already organized by gin, farmer or by merchant.

Some of these issues probably do not represent barriers to using gin classification data but rather reflect different priorities. For example, the hectic nature of warehouse receiving could be alleviated by hiring additional employees. Although some warehouses may be organized by gin, farmer or merchant, there is nothing to stop warehouses from organizing by bale quality within those categories.

Generally, the potential to slot by gin classing data would be less applicable for those warehouses whose customers use the Engineered Fiber Selection (EFS) system, since the EFS tends to select bales based upon a distribution of grade categories rather than a single band of grade categories. Other factors could impact the current feasibility of warehouses shipping cotton by class. The best approximation available currently is represented by the opinions of the warehouses themselves. Under current attitudes and practices, the market for gin classification data would be relatively small. For example, in the WSA survey of warehouses, only those warehouses representing about 19 percent of the total warehouse capacity in the sample indicated that the availability of classification data would improve their storage and handling of bales.

Savings per bale - The savings per bale depend upon the extent to which bales are pulled, consistent with the classifications by which bales are stored.

Cost per Bale/Cost of Implementation – As noted previously, slotting by bale classification could add cost to inbound receiving costs. More employees, equipment, and receiving areas may be required to organize inbound bales by classification rather than simply arrange bales in PBI tag order.

The current equipment that provides gin classification, USTER's INTELLIGIN, is generally leased. Users pay a fee per bale of $1.50 to $2.50 plus a fixed fee for equipment installation. A spokesman stressed that the cost of INTELLIGIN should not be considered in isolation as a way to improve warehousing efficiency. It also improves the functioning of the gin.

Likely Industry Opposition – Because this would be a matter of choice for the specific warehouse/gin/producer, the overall industry opposition would likely be minor.

Likely Industry Inertia – Properly implementing this approach would require coordination along the cotton supply chain so that warehouses would know how to set up categories. They would need to work with mills and merchants to establish the appropriate categories by which to group bales. This need to coordinate may be hindered by other segments' unwillingness to cooperate.

Merchandizing 6b	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	3	3
Updated Rating	3	2

Priority: Combine with following hypothesis
Timing: Long term

Merchandizing 6c: Perform USDA classification at the gin

Hypothesis: Perform USDA cotton classification at the gin, grouping cotton by yarn category through coordination between the gin and the ultimate mill recipient

Percentage of Market Impacted – The percentage of market impacted would be those gins that are able to identify the correct cotton to be used for yarn categories for mills. One challenge that would need to be overcome is the lack of consistency between harvests. A gin's cotton may meet a mill's needs one year but not the next. The gin would need to track the needs of multiple mills and characterize its cotton accordingly. Although this is a somewhat far-off concept, it is a logical improvement to cotton flows. As far up the value chain as possible, bale characteristics should be linked with a final product.

Benefit per Bale – The logical benefits of this approach per bale would be the reductions in shipping costs as described in the previous hypothesis. A theoretical benefit would be the superior marketing of bales. Because the fiber qualities would be linked to specific products, bales could be better marketed. The additional information would add value to bales on top of the basic bale classification that adds value to U.S. bales today.

Cost per Bale/Cost of Implementation – As noted previously, slotting by bale classification could add cost to inbound receiving. More employees, equipment, and receiving areas may be required to organize inbound bales by classification rather than simply arrange bales in PBI tag order.

As mentioned in Technical Memorandum #1, USTER Technology is currently developing technology which will enable gins to provide similar classing data as USDA classing offices. Performing USDA classing at the gin would require a number of different incremental costs:

1. A system for monitoring gin classing equipment to ensure that it is accurate and reliable;
2. Regular calibration of the equipment;
3. The cost of the classing equipment itself;
4. A monitoring system that would enable gins to address the legal ramifications of their new responsibility to provide classing data; and
5. A system for handling gin classification data.

The consulting team spoke to a representative of USTER Technologies. The company believes that developing a system to monitor gin classing would not be difficult. In the U.S., HVI machines are monitored and calibrated by periodic sampling of classification samples. About one percent of samples are retested, compared, and if the HVI machine yields a reading outside a given tolerance from a reference machine, the machine is recalibrated accordingly. China has a much larger number of classing offices, 87, compared to the 10 in the U.S., and machines are monitored online. Machines share vital parameters with a central computer in Beijing. Presumably, a similar online system could eventually be implemented in the U.S. to electronically monitor gin classing instruments. However, there are two things to note: 1) the USDA AMS is capable of classing every bale of cotton produced in the U.S. Every day, the USDA AMS monitors classing lines under its jurisdiction. If a line loses its calibration, it is taken off-line and adjusted. In addition, each day random samples from classing lines are selected and sent to Memphis for rechecking; and 2) the Chinese system was modeled after the USDA AMS system.

The representative from USTER declined to speculate on the likely fees for the gin classification system. Presumably, users would be charged a fee per bale, similar to the current usage of INTELLIGIN. It is likely that the user fees would decline over time as the machines gained broader usage and USTER proceeded down the “learning curve” in producing the equipment. Apparently, the initial fee for usage of INTELLIGIN was $5.00 per bale, but this declined to the current $1.50 to $2.50 as USTER improved its processes.

One potential issue could be economies of scale. If bales were classed at the gin, this could potentially require more machines. The USDA currently operates about 290 HVI machines to class the entire U.S. crop. This would translate to one machine per every 40,000 to 80,000 bales, depending upon the size of the year’s crop. During the 2008/2009 crop year, the largest gin produced 130,000 bales, while the average gin produced about 17,600 bales. Only very large gins currently process as many bales as a HVI machine in the current USDA classing offices. However, this could change as the ginning segment continues to consolidate.

Likely Industry Opposition – If gin classification were to require an adoption of a separate USDA classing function to monitor gin-based classification, this could cause some industry opposition, if the cost were to be shared by warehouses/gins that do not participate in gin-based classification. Also, shippers and mills may oppose a change from the current system where bales are classed by a third party (USDA). They may also oppose potential increases in the cost of classing.

Likely Industry Inertia – To properly implement this approach would require coordination along the cotton supply chain, so that warehouses would know how to set up quality categories. They would need to work with mills and merchants to establish the appropriate categories by which to group bales. This need to coordinate may be hindered by other segments’ unwillingness to cooperate.

Conclusion - The adoption of gin classification of cotton would be costly and difficult to implement. However, it would represent a logical step to improve the flow of cotton, so that the industry can know the fiber characteristics of bales as they are created and stored in warehouses instead of several days later. The taking and shipping of samples is a cumbersome process and should eventually be eliminated. As USTER points out, the gin classing data could also provide feedback to help improve ginning.

Merchandizing 6c	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	5	1
Updated Rating	4	2

Priority: High
Timing: Long term

Study Team Recommendations for Merchandizing

Merchandizing 7: Customer focused supply chains

One possibility could be to create multiple merchandising approaches for different markets. For bales destined for price-sensitive customers, bales can be grouped together into MARK lots following ginning. These bales would be stored in discount warehouses, which do not need to maintain the staffing to rapidly ship orders by the individual bale. It would be understood that orders from these warehouses will be shipped in container-load quantities of "recaps." Preferably, bales would be pooled into larger orders in order to take advantage of a volume-dependent transportation rates.

On the other end of the spectrum would be the hyper-responsive supply chains, in which cotton bales are pre-positioned at locations close to the ultimate consumers of bales. These would be in forward distribution centers in Asia, the Middle East, or wherever dictated by the needs of customers. Bales would be selected individually to meet customer specific demands.

This Working Paper recommends that the cotton industry investigate potential ways that a "low cost" cotton channel could be established. Potentially, this could be coupled with a low cost production region. The applicable warehouse or portion of a warehouse would charge substantially lower tariff rates than would be typical of other warehouses in the region. In return, the warehouse would operate at lower operating costs, since it would only ship in MARK units. The MARK units would not be assembled in a haphazard fashion. Each MARK would be based upon a specific set of modules as they were processed at a gin. Preferably, transportation costs would also be minimized.

The cotton industry should also investigate the possibility of establishing forward distribution centers for those customers who need just-in-time delivery. These would be established at a point in Northern Asia, Southern Asia and perhaps in the Eastern Mediterranean. These facilities could be fed by the staging of current sales and open bales for future sales. The open bales could potentially be shipped directly to the warehouse from the gin, particularly if gin-based classing data were available to help determine whether and where the bales should be forward staged.

While this approach may require some or all bales to be double warehoused and the moving of bales to a market area would entail some risk, the transportation savings could, to some extent, counteract these additional costs. If these facilities are fed with steady quantities of shipments, these facilities would eliminate congestion. They could also allow shippers to take advantage of 45-foot containers, since these containers are not abundant and may not be available for moves that are not being pre-staged. After orders are placed by mills, delivery from the forward distribution centers would be in days or two weeks instead of six plus weeks.

The study team spoke with a representative from a similar facility which serves Mexican markets. This warehouse at the U.S./Mexican border serves mills within Mexico and promises mill customers a 24-hour turnaround time. Sellers at forward distribution centers in Asia and the Eastern Mediterranean would need to identify preferred Incoterms. Generally, ownership of cotton transfers at U.S. ports as cotton is loaded onto the vessel. However, buyers at forward distribution centers may benefit from delayed change of ownership. This may help U.S. sellers to transact with foreign mills that have limited credit. The usage of forward warehouses is already common in the cotton industry. For domestic mills, some merchants provide consolidation centers that can provide just-in-time service if needed. Some merchants and logistics companies maintain forward mills abroad. However, an industry coordination of this effort could yield benefits in terms of maintaining economies of scale in terms of the forward distribution locations.

The creation of multiple cotton supply chains would be analogous to the railroad industry. For many years, the rail industry essentially provided a single service manifest train service. These were trains comprised of cars bound for many different places. Rail networks essentially operated at a single speed in which railcars were switched into and out of multiple trains and spent much of their time in transit in classification yards. None of the service was scheduled, so that trains would not leave classification yards until enough cars were assembled to justify the transit of the train. Railroad finally began to experiment with alternate service patterns with the establishment of unit train service (80 cars or more bound for the same destination in a single train), and intermodal containerized service. Railroads have since been experimenting with a range of service options, including a broad array of expedited intermodal container service and scheduled carload service, where trains leave classification yards at specific times, regardless of the number of cars, and a variety of expedited intermodal services to meet the unique requirements of customers. The cotton industry could do likewise, departing from the established patterns whereby all bales are stored the same way, positioned in the same facilities, and shipped in the same manner. Some bales could pass through a low cost/low service supply chain, while other bales pass through a high cost/high service supply chain.

Merchandizing 8: Alternate chains of custody

The cotton industry is somewhat unusual in the extensive involvement of intermediaries, i.e. merchandisers between cotton customers and the end users of the product. As discussed in a previous Working Paper, the hardwood supply chain operates on a very different model. Sawmills frequently sell directly to foreign buyers through foreign agents. The logistics of international shipments are then arranged by third party logistics providers and freight forwarders. Lumber ownership passes directly from the saw mill to the foreign buyer. By contrast, ownership of cotton will typically pass from a grower to a merchant or cooperative and then to a foreign buyer. Merchandisers provide important services in terms of buying cotton when farmers want to sell, and selling cotton when mills want to buy, as well as providing price risk management and other services. However, one issue with this approach is that the merchant can act as an information barrier between the growers and gins and the ultimate mill customer. For example, the study team spoke with several foreign mills that criticized the ginning of cotton in the U.S. Some of these were the inevitable result of cotton that is machine harvested rather than hand harvested. On the other hand, the study team had the sense that U.S. gins and growers were not fully aware of all of the issues with the international mills. No U.S. gin or U.S. producer in the interview group noted that they were attempting to meet the unique needs of a specific customer. It may benefit the industry to promote greater interaction between U.S. producers and gins and foreign mill buyers. Cotton Council International and Cotton Incorporated currently have ongoing exchanges that involve U.S. producers, ginners and other industry representatives to meet with foreign mills to share information. Potentially, foreign mills and their agents could be encouraged to buy U.S. cotton through The Seam.[39] U.S. producers and gins could be educated on how to sell cotton abroad directly, in terms of how to interact with freight forwarders, etc.

Recommendations Regarding Data Systems

Exhibit 82 is a summary of issues that have been identified in the study, proposed solutions, and solutions preferred by the study team.

[39] The company currently operates an international version of The Seam. However, this operates more as a bulletin board compared to the U.S. version, since transactions cannot be guaranteed.

Exhibit 82: Data Systems Issues, Proposed and Preferred Solutions

Issue	Proposed Solution(s)	Preferred Solution
Bale classing data unknown by warehouse when bale arrives	Gin classing	Establish a pilot program whereby the feasibility of performing USDA classing at the gin is assessed.
Warehouses operate in a "data poor" environment	Provide warehouse with additional access to the EWR system	-Encourage warehouses to enrich their data and workplace environment through better integration of office and plant management systems -After some allotted period of time, warehouses should be able to review the ownership of bales -Add functionality so that provider system has a "read only" level of access -Continue to investigate ways that RFID could help warehouses to be more efficient, considering the ROI of such investments
Shippers and logistics firms are unaware of shipment status at warehouses	-Make better use of existing tools -Explore usage of automatic notifications -Add functionality to internet based applications/websites like "IsMyLoadReady.com" so that shippers, freight forwarders, truck dispatchers, etc., can determine the status of loads	-Make better use of existing tools -Explore usage of automatic notifications -Add functionality, so that shippers could determine if loads have been picked up in IsMyLoadReady.com
Shippers place orders in an inefficient manner with little knowledge of the demands placed on warehouses	-Develop and enforce a universal bale locator code -Develop a "universal translator" which could translate between bale locator IDs	-Develop basic elements of a universal bale locator code, without necessarily agreeing on the entire format. -Provide incentives/disincentives to shippers to minimize the number of locations from which bales are pulled

Industry Supplied Recommendations for Data Systems

Data Systems 1: Bale location visibility

Hypothesis: Incorporate greater transparency of bale information such as specific warehouse location (within facility, within shed, within row/block) and software code to optimize balancing mill/shipper need with bale location such that bales can be optimally pulled from the closest proximity.

Percentage of Market Impacted – According to Cotton Incorporated (CI), the EFS MillNet software has a 95 percent market share among U.S. mills. CI noted they EFS software is being used in over 70 mills worldwide; however, with so many foreign mills they are unsure of the total foreign market share. Most shipments to foreign mills appear to not involve EFS picks, although some do. For simplicity's sake, EFS picks are assumed to equal the domestic mill consumption of U.S. cotton, which was 22 percent in the 2008/2009 crop year plus an unknown percentage of exports.

Impact per Bale – The study team has reviewed several EFS shipping orders. Nearly all bales were from different warehouse locations and it is assumed that other EFS shipping orders are similar. Other shipping orders reviewed by the study team selected bales from as few as 18 locations. Even if the functionality described above enabled warehouses to pull from 30 locations, the improvement is still about 65 percent. This would result in a savings per bale of about $1.64.

Cost of Implementation – According to Cotton Incorporated, the EFS allows users to view bale location data. The issue is one of application rather than the software itself.

Likely Industry Opposition – It is doubtful that there will be too much opposition to this idea.

Likely Industry Inertia – The concept of selecting bales by location is in some ways contrary to the EFS logic of selecting bales by a quality distribution curve. The fiber characteristics of bales within specific warehouse buildings tend to differ from the fiber characteristics of bales within other warehouses. Some warehouses are filled with bales stored early in the season, while other warehouses are filled with bales stored late in the season, etc. In order to maintain a consistent distribution of fiber characteristics, EFS pulls will typically select bales from multiple warehouses locations.

Data Systems 1	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	4	3
Updated Rating	3	2

Priority: Medium
Time frame: Medium term

Data Systems 2: Expanded access to EWR data

Hypothesis: Allow freight forwarders and other interested parties access to the EWR system to improve scheduling, etc.

Currently, a deposition holder on the EWR system can allow anyone else to view his information. He simply gives them the right, by providing them a password (which he can easily obtain) to do so. Federal regulations forbid anyone other than the holder of receipts (and agents designated by him) from viewing those electronic warehouse receipts. To allow "others" to view the receipt information (without holder permission) would require a change in federal regulations.

It is not certain what benefit "others" would gain from access to EWR. This hypothesis is part of an overall initiative to improve the level of communication between various segments of the cotton industry. Perhaps, this hypothesis should not single out the EWR system but should be part of an overall resolution to improve communication with supply chain partners.

Data Systems 2	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	4
Updated Rating	2	3

Priority: Combine with other initiatives
Time frame: Medium term

Data Systems 3: Better use of e-commerce tools for logistics communications

Hypothesis: Improve the usage of e-commerce tools to communicate with logistics firms

The study team's communication with logistics firms suggests that these individuals would benefit from improved communication with cotton warehouses. In particular, logistics providers would like to know when orders with warehouses would be available to ship. For example, if a merchant requests that a transportation provider pick up a load on a given date, the transportation provider would like to know that the warehouse will actually be able to put the load together by that date. According to one transportation provider, about 80 percent of warehouses in Texas provide access to shipping calendars while about 20 percent do not. Those that do are generally the larger cooperatives. Most warehouses in the Mid-South do not provide online shipping calendars. It is the understanding of the study team that this functionality was originally the intent of Batch 23 files through the electronic receipt provider system. According to a recent NCC survey of warehouses and from EWR representatives, the Batch 23 files are not being used.

Logistics companies also would like confirmation that loads are actually ready on the arranged date. Again, transportation providers would prefer to have access to an online calendar. Large cooperatives provide this access, but smaller warehouses do not. EWR, Inc. has created IsMyLoadReady.com, which is intended to provide exactly this type of functionality. Although usage is below expectation, usage has increased recently.

Logistics companies would also like confirmation that their carriers have picked up loads as expected. This enables them to decide when and whether to pay an invoice. Again, large cooperatives provide this web-based functionality, but smaller warehouses do not.

If would be preferable if the industry could consolidate all calendar functions onto a single website, so that logistics providers did not need to check each warehouse company's website separately. Logistics companies could review shipping orders for multiple warehouses on a single website. Through IsMyLoadReady.com and Batch 23 files, this is what EWR, Inc. has effectively tried to do. The study team recommends that the industry adopt the following policy statement:

"The NCC should encourage the industry to make use of existing e-commerce tools such as Batch 23 files and IsMyLoadReady.com and create incentives for warehouses and shippers to use these tools. The NCC should encourage EWR, Inc. to add functionality to IsMyLoadReady.com, so that merchants and carriers could receive confirmation that loads were picked up. The NCC should also work with industry to explore ways to provide either a website or an automatic notification service to interested parties when shipping orders are picked up at warehouses."

Data Systems 3	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	4
Updated Rating	3	4

Priority: Medium/high
Time frame: Short term

Data Systems 4: Make better use of EWR system tools

Hypothesis: Make better use of existing tools under the EWR system, including calendars and Batch 23 files

EWR staff believes that there are many people who are still not familiar with Batch 23 files. The NCC should continue the process of educating the industry about the Batch 23 files. The study team spoke with a major transportation provider who was unaware of IsMyLoadReady.com. The study team recommends a policy statement that reads:

"The NCC should publicize and promote the benefits of using online calendars such as IsMyLoadReady.com, as well as continue to publicize and promote the usage of Batch 23 files."

Data Systems 4	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	3	3
Updated Rating	3	4

Priority: Medium
Time frame: Short term

Data Systems 5: Share classing data

Hypothesis: Under a confidentiality agreement, share classing data between the physical holder of cotton and the disposition holder

Warehouses normally create electronic warehouse receipts before classing data are available. The warehouse will then send the receipt to the disposition holder, who is usually a gin or a cooperatives. The gin or cooperatives then receives the classing data and can place it on the receipt. If the gin or cooperatives decides not to do so, the receipt will not have classing data. Theoretically, the disposition holder could provide the warehouse with a password, and the warehouse would have access to that data. One issue with this approach, however, is that the warehouse would then not only have access to the information, but also the ability to initiate transactions. While one would not expect a warehouser to abuse the privilege, the ability would make the disposition holder hesitant to share this access. It was highlighted by one shipper's senior trader who indicated that he would like to grant access to a few other traders, but not grant those individuals the ability to release cotton. This concern could be alleviated if the EWR system had a second or separate level of access such that users could view data but not initiate transactions. This study team recommends a policy statement that reads:

"Discuss with EWR, Inc. the possibility of creating different levels of access to the EWR system whereby some users could be granted 'read only' access with the ability to view data, but not initiate transactions."

Data Systems 5	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	4
Updated Rating	2	4

Priority: Low
Time frame: Short term

Data Systems 6: USDA allows warehouse access to bale owner's name

Hypothesis: After some allotted number of months (12 to 24), the warehouse should be able to access all data fields in regards to bales remaining in the warehouse so he can clear his books and better manage his space

The USDA has made a policy of maintaining the confidentiality of the bale owner at the request of the cotton industry. USDA provides the name of the disposition holder to warehouses on a "case by case" basis. In many or most cases, the USDA will provide the name of the bale owner for those bales that are "upside down," i.e. the storage fees owed on a bale are higher than the value of the bale. However, this “case by case” policy leaves the decision to the judgment of the USDA official. This Working Paper recommends a policy statement that reads:

“The NCC should provide to the USDA a specific set of policy recommendations to cope with the issue of bales left at warehouses for an excessive length of time. This policy should provide the USDA with guidance regarding those circumstances under which the USDA should divulge the identity of a bale’s owner to the physical holder of a bale.”

Data Systems 6	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	5
Updated Rating	2	5

Priority: Low
Time frame: Short term

Data Systems 7: Enforce bale location code

Hypothesis: Enforce a Consistent Warehouse Bale Locator Code

Percentage of Market Impacted – Theoretically, the market impacted would be all shipping orders from merchants to unaffiliated warehouses. Generally, marketing cooperatives would maintain internal systems which would enable them to interpret the location of bales within their own warehouses. Therefore, this hypothesis would be inapplicable to those shipping orders by marketing cooperatives from their own warehouses. Most merchant warehouses would be expected to be consolidation warehouses. Merchants and cooperatives own 45 percent of the warehouse capacity in the U.S. However, not all cotton delivered from cooperative warehouses is ordered by the merchandizing arms of those cooperatives. Unaffiliated merchants may also pull cotton from cooperative warehouses. Merchants own about 15 percent of U.S. warehouse capacity. This hypothesis would impact probably somewhere between 55 to 85 percent of the market.

The usage of bale locator codes to minimize the number of structures from which bales are pulled per shipping order would tend to be more applicable to larger warehouses. For smaller warehouses, there is a concern that focusing orders on particular buildings will tend to skew the quality of cotton available at that warehouse. An underlying assumption is that the various structures within a warehouse complex will tend to have different qualities of cotton. Some structures may have been filled early in the season, while others may have been filled late. Some may be filled with a certain gin’s cotton, while others may be filled with another’s. Each of these differences will lead to different quality characteristics. If shipping orders dwell on a single building, that quality characteristic will be depleted. But the extent to which this is a concern will also depend upon the specific shipper’s practices and whether the merchandiser is a cooperative.

A cooperative with its own inventory of cotton will tend to be more concerned with how it draws down that inventory than a shipper that rapidly assembles lots from a variety of sources to meet a spot purchase from a customer.

Savings per Bale – The results of the survey by Phil Kenkel[40] suggested that on average these warehouses believed that if all buyers would coordinate bale location information in order to minimize the number of structures involved in a shipping order, the increase in efficiency would be 15 percent. Because the survey focused on cooperatives, the results may not be representative of the whole warehouse sector. These warehouses are more likely to benefit from coordination with merchants or their own merchandizing branches than would small independent warehouses. Therefore, the 15 percent figure could represent a conservative estimate. Multiplied by the estimated cost of pulling bales at $2.50 per bale, this would equal $0.38 per bale.

Cost of Implementation – To enforce a consistent bale locator code would not be costly to implement. CI is currently developing Cotton Expedite, a software program aimed at merchants. This will include functionality by which merchants will be able to consider warehouse location when selecting cotton from warehouses.

Likely Industry Opposition – Industry opposition is likely to be significant. Each cooperative will prefer that their bale locator codes become the industry norm. However, it may not be necessary to agree upon a universal bale locator code. The consulting team interviewed a warehouse and a merchant that successfully coordinate bale and warehouse location information. The system used by these two parties is uncomplicated. The first number of the location code consists of the “plant location” code. This refers to the structure within the warehouse complex. The set of characters is the “plant location,” which refers to the bale’s location within the warehouse. However, the merchant does not dictate a specific format for the “plant location” code. The merchant only needs to know that bales are located in one plant location. The industry does not need to agree upon a full bale locator code, only certain elements. For example, if the industry only agrees that the first several characters are the structure number, the second several are the block or row number, this may be sufficient for the time being. More specific designations could come later.

Likely Industry Inertia – As mentioned previously, the greatest barrier to using bale locator codes to improve the efficiency of shipping orders may result more from industry practice rather than the lack of a consistent format. Industry inertia will be an issue. As mentioned above, some merchants may be hesitant to direct warehousers to a specific structure for fear that this will skew the distribution of cotton in the warehouse as inventory is depleted. Others simply may not feel that they have an incentive. One industry representative discussed the possibility of

[40] *Cotton Warehouse Survey* by Phil Kenkel of Oklahoma State University, 11/13/2008.

penalizing shippers for pulling cotton from too many warehouses. This may only encourage shippers to place small shipping orders, since small orders would be unlikely to be pulled from as many warehouses. Furthermore, merchants may avoid that warehouse or purchase cotton from that warehouse at a discount. Another option could be to include both a "carrot" and a "stick." The merchant would incur a penalty if a shipping order is pulled from too many buildings and a discount if the shipping order is pulled from few buildings.

Another issue will be the warehouser's willingness to keep its records up to date. Most warehousers place the initial location of a bale on the electronic warehouse receipt, but few update this information after that. On the other hand, the NCC warehouse flow survey suggests that bales seldom change locations within warehouses. Most location codes identify a row or block within a shed, but doesn't give any further details.

Conclusion – While it may not be as important to agree on a universal code, it will be important to agree on certain elements, such as the location of the building code, and perhaps block and row numbers. A merchant does not need to know exactly how to define location codes, only that bales share that location. However, the bigger challenge will be to expand the usage of bale locator IDs by shippers to improve the efficiency of shipping orders. This is already used by at least one merchant with a number of warehouses today. It has significant promise to be expanded.

Data Systems 7	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	4	2
Updated Rating	4	3

Priority: High
Time frame: Medium term

Data Systems 8: Create an EWR universal translator

Hypothesis: Create a translator, which could make bale location codes appear consistent, although individual warehouses continue to use their own system

Percentage of Market Impacted – Same as previous hypothesis.

Savings per Bale – Similar to the previous hypothesis, the increase in efficiency could be 15 percent on the conservative side. Multiplied by the estimated cost of pulling bales at $2.50 per bale, this would equal $0.38 per bale.

Cost of Implementation – EWR, Inc. told the study team that it would charge a minimum of $200,000 to produce a universal translator. The translation table would also require significantly more processing than EWR's server can currently handle. The current server has high storage and memory capacity, whereas a new server to support the translation tables would need to have more processing speed. The current server would cost $50,000 to replace. If one used the cost of the old server as a proxy for the cost of a new server, the total cost of creating a translator for bale location codes would be $250,000.

EWR also specified that they would have the right to charge for each transaction.

Likely Industry Opposition – Some industry participants may balk at funding the development of translation software.

Likely Industry Inertia – Same as previous hypothesis.

Conclusion –As mentioned previously it may not be necessary to reach agreement on a complete bale location code format, only certain elements. The exact meaning of bale locator codes is less important than the fact that bales share a location. As mentioned previously, the usage of bale location codes to improve the efficiency of shipping orders has a high potential to improve flows.

Data Systems 8	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	4	3
Updated Rating	4	3

Priority: High
Time frame: Medium term

Study Team Recommendations for Data Systems

Data Systems 9: Optimized pick lists and grouping of orders

Picking orders represents at least 50 percent of the operating expense of most warehouses, regardless of the industry. In the case of the cotton industry, assembling shipments represents the greatest bottleneck to cotton flow. Working Paper 3, Cotton Industry Data Methodologies, mentioned that cotton warehouses generally do not use software to optimize pick lists. In other industries and other warehouse management systems, this software logic is used to help group orders and sequence picking in an optimal fashion. Rarely do WMS systems actually support pick path optimization. It would be difficult for systems to do so, since the software would need a detailed map of the facility layout to determine the shortest path between any two points within the facility. This would be time consuming to gather. Furthermore, this information would need to be communicated to warehouse workers. The communication could be complicated and may confuse the worker. Any updates to the facility would also need to be updated into the algorithm used to calculate desired paths. Most WMS generate pick lists by recommending a sequence of picks to the picker. Usually, this is based upon simple pick order algorithms. All locations within the warehouse are sequenced from nearest to farthest from a designated origin point.

The problem of developing an ideal path for fulfilling warehouse pick lists has been widely studied and is commonly referred to as the “traveling salesman problem” (TSP). The traveling salesman attempts to minimize the area traveled while serving his market area. One alternative put forward to developing an optimal path for each pick list is to develop a global path. This is a pick path that may not be best to fulfill every pick list, but is close. It can be modified to meet the needs of specific orders. Pick path optimization generally provides the most benefit for warehouses that have many slow moving items. The typical order uses a significant portion of the warehouse complex, but not all. TSP problems can be solved using a range of algorithms. Under exact algorithms, all alternatives are considered and the best alternative is selected. The problem with this approach is the complication and mathematical computation that frequently accompanies these calculations. Other approaches are “heuristic” approaches, in which multiple options are tested. A preferable alternative is selected, but this alternative may not be the very best alternative.

It is recommended by the study team that the cotton industry investigate preferred pick orders and pick paths for optimal cotton warehouse layouts. This could likely result in a series of simplified rules that cotton warehouses could apply to their pick lists to improve their efficiency.

WMS can also support the grouping of picking operations. In general there are four primary approaches to warehouse picking:

- Basic order picking: One order is picked at a time;
- Batch picking: Several orders are combined into a single pick list. Orders must be accumulated in the system until there are enough similar picks to create the batches. This is most often used in small item warehouses where orders are assembled on a multi-tiered picking cart;
- Zone picking: In zone picking, the picking area is broken up into individual pick zones. Order pickers are assigned a specific zone, and only pick items within that zone. Orders are moved from one zone to the next as the picking from the previous zone is completed (also known as "pick-and-pass"); and
- Wave picking: Wave picking is used in very busy warehouses. It helps to ensure that picking operations do not interfere with one another. All zones are picked at the same time and the items are later sorted and consolidated into individual orders/shipments.

Most cotton warehouses use some combination of batch and zone picking where workers focus on specific warehouse structures as they complete multiple orders at a time. A range of algorithms have been developed to decide which orders are included in which batches and how to establish the zones where batches will be pulled. The two primary algorithms used in batching orders are seed algorithms and savings algorithms. Under seed selection, a single order is designated as the “seed” of the batch. Seeds are selected by a range of criteria, including: a) random, b) by order with a large number of locations and c) by order with the longest or most distant tour. Other orders are added to the batch based upon “order congruency” rules. These can be based upon: a) the number of additional locations that must be visited as a result of the additional order, b) the difference between the gravity center of the order and the gravity center of the seed order and c) sum of the distance between every location of an item in the order and the closest location of an item in the seed order. Savings algorithms calculate the savings that result from combining multiple small tours into a smaller set of large tours.

In developing a series of best practices for developing pick lists at cotton, warehouses it may be worthwhile to investigate whether a simplified set of rules could be created from the various algorithms used to group orders.

Data Systems 10: Utilize radio frequency identification (RFID)

RFID is a generic term that refers to a range of technologies that use radio waves to identify people or objects. The basic elements of an RFID system are transponders, readers, and antennae. The RFID tag is basically a microchip connected to an antenna. The reader communicates with the tag by radio waves. The primary difference between an RFID tag and a barcode is that an RFID tag can transmit to the reader by radio waves and does not need to come into direct contact with an optical scanner/reader as is the case with barcodes. An RFID reader can receive data from as many as 1,000 tags per second. Radio signals can pass through a range of non-metallic substances.

RFID tags come in several classifications, including read/write or read only. Data stored in read/write tags can be edited, but only if the tag is within the range of the reader. Data stored on read only tags can be read but not edited. Read/write tags are more expensive. RFID tags can also be categorized as active, semi-active, and passive. Active tags contain a battery that powers the microchip and allows it to transmit a signal to the reader. Semi-active tags contain a battery to run the circuitry of the chip, but must draw power from the magnetic field of the reader in order to communicate with the reader. Passive tags rely on the magnetic field of the reader to create power to transmit to the reader. Recently, most tags were passive transponders that could store only 32 to 128 bits of data. The information they contained would generally consist of only an identification number, similar to a barcode. Tags have improved recently, and passive tags can store larger quantities of information. RFID tags also vary by the frequency at which they transmit. Low and high frequency tags are less expensive than ultra high frequency (UHF) tags but have lower ranges, only a few inches to several feet. By contrast, UHF tags are more expensive, draw more power, but have ranges of 25 feet or more.

As discussed in Working Paper Cotton Industry Data Methodologies, the usage of RFID technology received a boost in 2004 when Wal-Mart mandated usage of RFID tags by its top 100 suppliers. The Department of Defense, Target, and Albertson soon initiated their own pilot programs. However, several years later the sense within the supply chain community was that most suppliers were only using RFID to comply with a mandate and that the return on investment (ROI) associated with the technology was uncertain at best. For example, in a 2009 survey of consumer products companies by EPCglobal, 83 percent of respondents indicated that they were adopting RFID at the request of a trading partner, while 13 percent were adopting RFID in order to improve their operations or supply chain.[41] Interesting to note, none of the companies indicated that they were tagging 60 percent or more of their cases or pallets.

The typical concerns with using RFID tags are as follows:

- Sequencing. RFID tags are not read within any particularly sequence. If the sequence of reads is important, the technology will be less useful;
- Conveyance speed versus tag reader. In cases where products are moved quickly through the read area, the reader may not have time to read the tag;
- Orientation of the tag. In some cases, the orientation of the tag to the reader may impact the communication between the reader and the transponder;
- Antenna overlap. Results can be unreliable if read zones overlap;
- Reliability. Reliability has improved recently. In several recent studies, RFID tags were found to provide read rates of 99 to 100 percent;
- Certification. Security policies need to be established to ensure that the source and content of data on tags is as represented;
- Interoperability. RFID data must be able to operate with other information technology systems; and
- Cost. The cost of the technology, including hardware and implementation remains an issue.

The cost of RFID technology has decreased significantly. Tags have more memory, have much larger ranges than the tags of ten years ago, and can cost less than a dime.[42] Furthermore, the cotton industry may have unique needs that are less applicable to other industries that make the technology particular suitable. For example, consumer products companies may debate whether they should tag at the unit level, a level of detail that may not be justified by the underlying product. By contrast, cotton bales are worth several hundred dollars and may better justify tracking with a $0.10 RFID tag. As mentioned in Working Paper Cotton Industry Data Methodologies, the primary benefits of RFID technology are as follows:

- Eliminate shipping and receiving errors. Inbound and outbound shipments pass through a read zone and are compared to advanced shipping notices or to manifests. For outbound orders, if an operator begins to load a bale onto the wrong truck the system can alert the user;
- Eliminates the need for scanning. The time otherwise spent scanning bar codes is eliminated;

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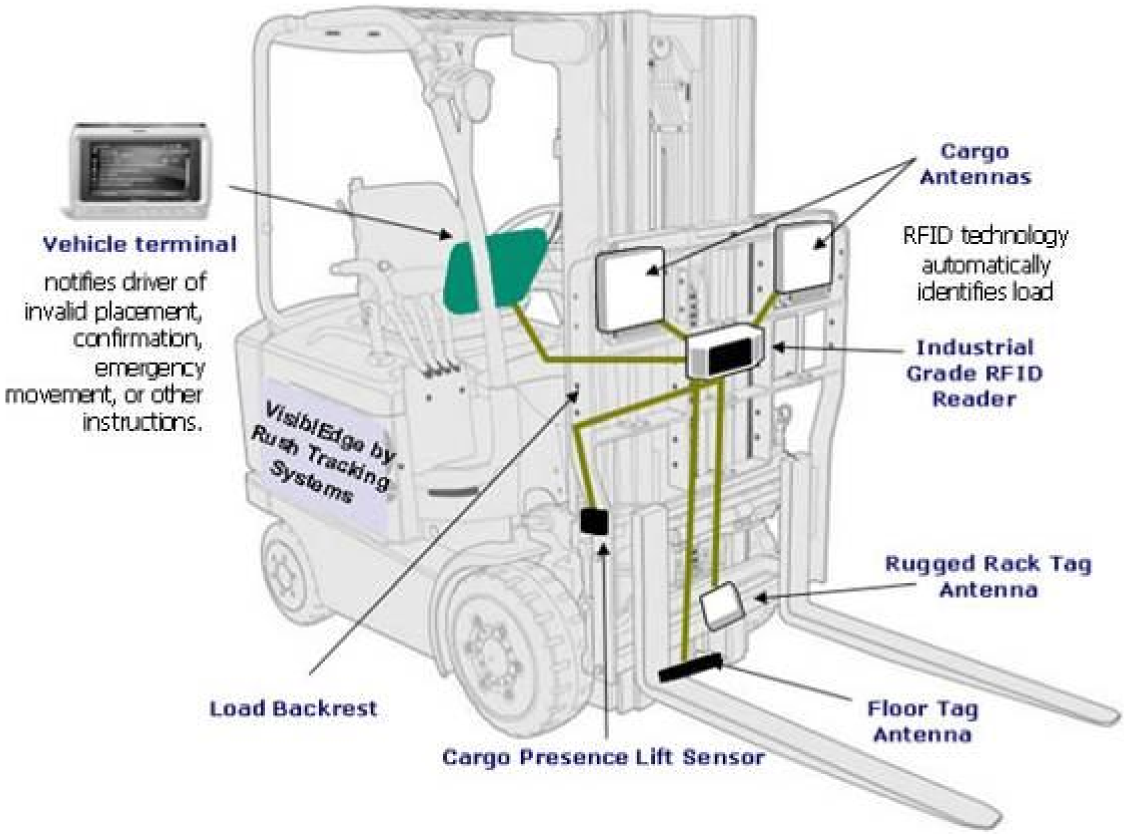
[41] Clair Swedberg, "EPCglobal US Survey Finds Strong RFID Foundation in CPG Sector," *RFID Journal*, February 1, 2010.

[42] Maida Napolitano, "Warehouse and Distribution Centers: RFID Revisited," *Logistics Management*, February 1, 2010.

- Trace. Tags can record all events that occurred to a given bale or lot; and
- Inventory control and accuracy. Readers can point to the specific location of a given tag. Readers can also confirm what has left or entered the warehouse;

The study team is aware that there is a possibility for RFID tags to replace or augment barcode PBI labels. Furthermore, at least one warehouse has considered the usage of the technology as adopted in a grid pattern. Under this system, RFID tags are embedded into the floor of the warehouse along a grid pattern. RFID antennas are placed into the clamps of clamp trucks. A second floor tag antenna is placed onto the base of the clamp truck. The antennae feed into a reader that is located on the lift vehicle **(Exhibit 83)**. A cargo presence lift sensor triggers when the RFID reader turns on and off.

Exhibit 83: VisiblEdgeTM Equipped Fork-Lift



As bales are lifted and set down, the tags in the floor would provide location information while the tags on the bales would provide bale identification information. The system is similar to that used by International Paper at its Texarkana, TX warehouse. There are several benefits that International Paper realizes through this system including:

- Greater accuracy in slotting and shipping. If warehouse workers place an item in the wrong location or pick the wrong product, they receive an alert. The location of each item is known within inches in the warehouse;

- International Paper had previously had problems with barcodes that were stripped from rolls of paper. Under this new system, RFID tags are embedded deep within rolls of paper where they are not likely to be removed accidentally from rolls; and
- The company has also improved its ability to monitor the efficiency of workers as well as the usage of equipment.

Another potential use of RFID technology could be in finding bales. RFID readers can have directional antennae. The readers can have adjustable interrogation zones. If a warehouse employee is unsure of the exact location of a bale within a block, a directional RFID tag reader can be used to identify the specific location.

This study team recommends that the cotton industry perform a cost/benefit analysis of the use of RFID technology. This analysis should identify the best use of RFID technology for the cotton industry. It could start with an analogous system to that of International Paper, but should also consider other applications. The identified application would depend upon the needs of the cotton industry. For example, the analysis should consider the greater source of delay in picking bales from a warehouse, including the following processes:

- Travel time;
- Search time;
- Scanning time;
- Retrieval time; and
- Return time.

For example, if scanning time, search time, and order accuracy have been significant issues in the past, then a system similar to that of International Paper may be appropriate. If search time is the predominant issue, then a system with a directional RFID antenna may be the more appropriate solution. If travel time is the primary hindrance, RFID technology may not be the best solution. Rather, optimal pick order and pick path, or warehouse layout issues may be the better solution.

These areas of investigation are recommended.

Recommendations Regarding Warehousing

Exhibit 84 is a summary of issues that have been identified in the study, proposed solutions, and solutions preferred by the study team.

Exhibit 84: Warehousing and Shipping Issues, Proposed and Preferred Solutions

Issue	Proposed Solution(s)	Preferred Solution
Warehouses lack incentives to ship cotton in a timely manner and actually have incentives to delay shipping cotton.	-Eliminate flat direct rebates that warehouses provide to gins/producers that must later be recouped through storage charges if the warehouse is to profit -Change the system by which warehouses are compensated to deemphasize or remove the relationship between warehouse revenues and length of time that bales are stored -Increase the minimum shipping standard from 4.5 to 6.5 percent -Change trade rules so that warehouses can be compensated for providing expedited service	-Change trade rules so that warehouses can be compensated for providing expedited service
It is inefficient for warehouses to maintain capacity for peak shipping period at all times when these resources are seldom required.	-Provide teams of workers and equipment that could shift between warehouses to help meet peak shipping requirements	Not recommended, interviewees did not believe this to be cost effective
The cotton industry does not currently have a stacking method that is both efficient in terms of density of storage and efficient in terms of retrieving bales. Block stacking is an efficient use of space but is inefficient for retrieving bales. Row stacking is efficient for retrieving bales but is an inefficient use of space.	-Discourage block stacking - Reduce size of blocks - Sell and ship full blocks	Investigate alternate storage methods that could provide both density and ease of access, such as inexpensive racking, shuttle lifts.

Shippers do not always pick up bales in a timely manner, so that waiting orders clog shipping areas and in some cases, orders that have never been picked up must be restored or assembled into different orders.	-Encourage shippers to pick up bales in a timely fashion -Provide incentives to warehouses to work early shipping orders	Encourage warehouses to adjust tariffs so that late pickups do not pose a financial risk
Double warehousing adds cost to the cotton supply chain.	- Improve coordination between warehouses and shippers	Improve coordination between warehouses and shippers
Storage credits in the CCC loan program impede flow	Insure all warehouses operate with a CCC Cotton Storage Agreement and comply with the 4.5 percent minimum shipping standard	Insure all warehouses operate with a CCC Cotton Storage Agreement and comply with the 4.5 percent minimum shipping standard
Container/trailer loading could be more efficient	Consider automated container loader technology	Consider automated container loader technology

Industry Supplied Recommendations for Warehousing

Warehousing 1: Discourage block stacking

Hypothesis: Discourage Block Stacking

Conclusion – It would be very difficult to discourage block stacking. Many warehouses feel that they do not have enough room to stack in another manner. A better approach would be to develop an improved method of stacking or pulling bales which would provide the density benefits of block stacking while providing the access to bales that is provided by row stacking.

In a recent survey of warehouses by NCC, the average respondent that uses block stacking noted that the typical bale is moved about 10.0 times from the time it is received to the time it is shipped. The average respondent who uses row stacking estimated that the average bale is moved 6.5 times.[43] Therefore, block stacking requires bales to be moved about 53 percent more often. Per calculations listed above, the incremental cost of a warehouse employee and lift equipment is estimated to be about $18.97 per hour or $0.32 per minute. The time required to move a bale is unknown. However, if each bale movement requires one minute of time to move, the incremental

[43] This estimate is conservative since a number or respondents reported that the typical bale is moved in excess of 15 times, but no additional information was provided. To be conservative, the average number of times a bale was moved was assumed to be 16.

cost per bale of the extra handling from block stacking is $1.10 per bale.

Balanced against the additional handling cost associated with block stacking are the savings in space. The average respondent in the NCC survey who uses block stacking requires about 3.3 square feet per bale, in contrast to the average warehouse who row stack bales, and requires 4.4 square feet per bale. On average, therefore, the row stacking requires one third more space. The recent study by OSU of CGWA membership revealed that labor accounts for only about 29 percent of CGWA membership warehouse expense. The cost of operating lift trucks accounts for another five percent. If one were to assume that most of the remaining 66 percent varied by the size of the warehouse, the average cost per square foot would be about $1.78. Using block stacking would save $1.96 per bale in non-labor expense. On the other hand, this does not include the cost of potential lost savings in the cotton supply chain due to the delays caused by block stacking.

Warehousing 2: Increase shipping standard to 6.5 percent

Hypothesis: Increase minimum shipment standard from 4.5 percent to 6.5 percent

Percentage of Market Impacted – This would theoretically impact those warehouses that are not currently capable of shipping at 6.5 percent. This would not impact consolidation warehouses, which generally should ship at a higher rate. As mentioned in Technical Memorandum #1, merchants mentioned shipping between 20 to 30 percent of their volume from consolidation warehouses. Consolidation warehouses are therefore estimated to be about 25 percent of warehouse capacity, so this hypothesis would impact the other 75 percent.

Savings per Bale – The primary benefit of this initiative would be to increase the sales of U.S. cotton and to capture those sales that would otherwise be lost because some warehouses do not exceed the minimum shipping standard. Other benefits would accrue from the reduction in inventory carrying costs as cotton is delivered to mills. This would include reductions in the financial costs of holding cotton, as well as storage costs. Improved warehouse performance could also reduce the need for double warehousing. Merchants and other parties maintain consolidation warehouses for several reasons, including: having a large enough selection of bales available in one place to assemble orders and being able to ship in a more timely fashion than would be possible from a country warehouse. The incremental cost of moving cotton into a second warehouse could also be eliminated.

The increases in sales and savings in carrying costs would be difficult to quantify. One merchant stated that if bales were shipped in a more-timely manner, his sales could increase by 10 percent. However, this merchant also mentioned that this number was purely speculative.

The cost to merchants and other parties of maintaining consolidation warehouses because country warehouses are unable to release inventory in a timely manner equals: 1) the additional handling of bales to bring them into and out of the consolidation warehouse; 2) the difference in cost between maintaining a consolidation warehouse versus a country warehouse; and, 3) the incremental transportation cost of diverting a bale to a consolidation warehouse instead of sending directly to its destination market. Data from the Texas A&M University cotton flow least cost model suggests that using Memphis consolidation warehouses adds about $4.90 per bale in additional costs. However, it is beyond the scope of this research to determine the extent to which a move from a 4.5 percent to a 6.5 percent shipping standard will reduce the need for consolidation warehouses.

Cost per Bale, Cost to Implement - Warehousers have indicated that a shift to 6.5 percent would increase costs significantly. For example, the Phil Kenkel survey of CGWA membership suggested that a switch to a 6.5 percent shipping standard would increase total costs by about 13 percent. Given that the total warehouse cost per bale for the CGWA membership was about $12.19, so the total additional cost per bale of adopting the 6.5 percent shipping standard would be $1.61. This cost would impact all warehouses that comply with the standard. The study team spoke with a transportation provider who indicated that he and other logistics firms may not necessarily be able to secure enough equipment to ship at a 6.5 percent level. Therefore, switching to this standard may actually result in an increase in late pick up fees.

Likely Industry Opposition – Industry opposition can be expected to be strong. Data from the USDA suggests that since the USDA began to track bales made available for shipment (BMAS) data, warehouses on average have made available for shipment per week and shipped only about two percent of their capacity. Rarely are warehouses required to ship to the 4.5 percent standard, although this may change if cotton acreage were to increase in the future.

Likely Industry Inertia- Because this would be a mandatory program, industry inertia would be expected to be less of a factor. However, industry inertia may be an issue in terms of enforcing the 6.5 percent standard. Many claim that the 4.5 percent standard is already not currently enforced.

Conclusion – The study team does not recommend that the industry pursue a 6.5 percent shipping standard. Rarely are warehouses required to ship to 4.5 percent, and such an obligation would require warehouses to maintain capacity that they would rarely use. A better solution would be to address the root causes of slow shipping rather than impose an arbitrary shipping standard.

Warehousing 2	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	3
Updated Rating	4	1

Priority: Recommend not pursuing at this time

Warehousing 3: Labor teams

Hypothesis: Teams of customer pullers/stagers/loaders could be used by groups of warehouses or supplied by shippers to assure timely preparation of cotton for shipment and reduce costs

Conclusion: Many whom we talked to did not believe this idea to be cost-effective. The study team does not recommend pursuing this hypothesis further.

Warehousing 3	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	3
Updated Rating	2	2

Priority: Recommend not pursuing at this time

Warehousing 4: Eliminate rebates or incentives

Hypothesis: Eliminate rebates or incentives that allow warehouses to attract cotton for the storage and not the marketing advantage

Conclusion - Although rebates may indeed create an inducement for warehouses to store cotton until they have recouped the cost of offering the rebate, it is unlikely that a new industry policy will eliminate all incentives that warehouses may devise. This would also represent a significant intrusion into a warehouse's preferred way of doing business. The study team does not recommend pursuing this hypothesis further.

Warehousing 4	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	5	1
Updated Rating	5	1

Priority: Recommend not pursuing at this time

However, the study team does recommend an alternate policy statement as follows:

"The NCC should explore potential changes to trade rules and/or encourage changes to warehouse tariffs that would provide warehouses with an appropriate financial incentive to ship cotton in an expedited manner when necessary."

Currently, Memphis Cotton Exchange, Rule 5, Clause 1 for F. O. B. Cars, Trucks, or Containers states that:

"… Seller is to pay all charges … except patching and special service ordered by the Buyer. Charges for the Seller shall include compression, receiving, storage, sampling, any surcharge, all accrued taxes, stenciling one-line 5 letter mark, shipping and/or picking out by tag number and loading."

Effectively, this rule requires the seller to pay all charges including all "surcharges." As a practical matter, the seller would probably be required to pay for early shipping orders whether the buyer would use this service or not. Finding an appropriate change to this rule to allow warehouses to be appropriately compensated for expedited service could significantly improve cotton flow.

Warehousing 5: Encourage timely pick-ups

Hypothesis: Encourage shippers to pick up shipments from warehouses in a more timely fashion

Percentage of Market Impacted – According to data from the USDA, on average between 2008 and the third quarter 2009, shippers only shipped 80 percent of the bales made available for shipment per week. Thus, 20 percent were available but not shipped even though the vast majority of these shipments were eventually picked up. A majority of warehouse respondents for this study said that they had encountered problems with shippers not picking up loads. Most said that this occurred only rarely, particularly as the market declined over the past several years. One warehouse said that it happened once every 25 loads.

Savings per Bale – Delayed pickups of bales can be a nuisance but are not a consistent problem. Bales never picked up are costly in that they require unnecessary selecting and pulling of bales that then must be re-slotted. As mentioned previously, the estimated incremental cost of pulling bales is about $2.50 per bale. Bales waiting for pickup often clog loading areas and hinder the ability of warehouses to serve other shippers.

Likely Industry Opposition/Likely Industry Inertia – Industry opposition should not be significant. Generally, this issue relates to setting tariff structure. Some warehouses that were interviewed for this study charge shippers heavy penalties if they do not pick up shipments within a specified period of time. These charges cover the expense caused by the late pickups. The industry inertia may be somewhat of a factor if warehouses do not bother to change their tariffs.

Cost per Bale/Cost of Implementation – The cost of reviewing and revising warehouse tariffs is minimal.

Conclusion – The study team recommends a policy statement that reads:

"NCC should encourage warehouse members to adjust their tariffs in such a way that the failure of shippers to pick up shipments does not create a financial risk to the warehouse."

Warehousing 5	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	4	3
Updated Rating	2	5

Priority: Low
Time Frame: Short-term

Warehousing 6: Incentives for early shipping orders

Hypothesis: Provide incentives to warehouses for working early shipping orders

As mentioned in Technical Memorandum #1, most warehouses accept early shipping orders. Generally those that do not have had bad experiences in the past where shippers have submitted early shipping orders, the bales have been assembled, but the shipper did not pick them up, or the shipper sent one or several regular shipping orders that overlap with the early shipping order. These render the effort to assemble the early shipping order useless.

Discussions with warehousers suggest that this may, to some extent, be a matter of warehouses adjusting their tariffs. Some warehouses do not mind early shipping orders that are not picked up because their tariffs heavily penalize those who do not pick up orders. The study team recommends a policy statement that reads:

"NCC should encourage warehouse members to adjust their tariffs in such a way that the acceptance of early shipping orders does not pose a financial risk to the warehouse."

Warehousing 6	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	4
Updated Rating	2	4

Priority: Low
Time frame: Short term

Warehousing 7: Eliminate unneeded bale handling incentives

Hypothesis: Create incentives and/or eliminating disincentives for keeping cotton bales in initial receiving warehouses until needed by textile mills would generate industry cost savings thus eliminating unneeded handling, movement and transportation

Percentage of Market Impacted – In Technical Memorandum #1, merchants mentioned that they shipped about 25 percent of their volume from consolidation warehouses.

Benefit per Bale Shipped – Additional bale handling and transportation represent the primary incremental cost associated with double warehousing, which necessitates the movement of bales into and out of another warehouse. Bales are assembled into marketable lots in consolidation warehouses, so the incremental cost of pulling these bales should be less than that of pulling bales from a country warehouse. Data from the Texas A&M University cotton flow least cost model suggests that using Memphis consolidation warehouses costs about $4.90 per bale. In addition, the least cost model results in Scenario 8 suggest simply widespread lowering of regional country warehouse storage rates results in substantial cost savings, better utilization of country warehouses, and sourcing from country warehouses to final demand points. (A scenario of lower regional storage rates assumes that competition among warehouses would take the form of lower tariffs versus higher rebates.)

Cost per Bale – It is uncertain what the cost per bale shipped of this proposal would be, because of the uncertainty of the exact nature of the "incentives" and "disincentives." A system would need to be established to monitor the storage period of cotton in consolidation warehouses. In addition, the industry would need to agree on a definition of a "consolidation warehouse." Would this simply refer to any bale that is moved from one warehouse to another? Once a bale is moved to a second warehouse, the owner would then be required to regularly report how long the bale has been in his/her possession. This could create an administrative burden.

Cost to Implement – The cost to implement would likely consist of establishing the monitoring system described above.

Likely Industry Opposition – Merchants would oppose the idea of paying a penalty for keeping cotton in their own warehouses over a certain period of time.

Likely Industry Inertia – Because this would be a mandate, industry inertia would not be expected to be a significant issue.

Conclusion – The study team has not seen evidence which suggests that cotton flows would be improved if double warehousing were discouraged. At the same time, there are several good economic reasons why a shipper would move cotton to a consolidated warehouse,

Warehousing 7	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	2	4
Updated Rating	2	2

Priority: Recommend not pursuing at this time

Warehousing 8: Modify storage credits

Hypothesis: Modify or eliminate CCC storage credits to increase flow of cotton

Conclusion - This hypothesis was relatively unpopular with members of the cotton industry. The study team does not recommend pursuing this hypothesis further.

Warehousing 8	Net Benefit to Cotton Flows	Ease of Implementation
Preliminary Rating	1	3
Updated Rating	1	3

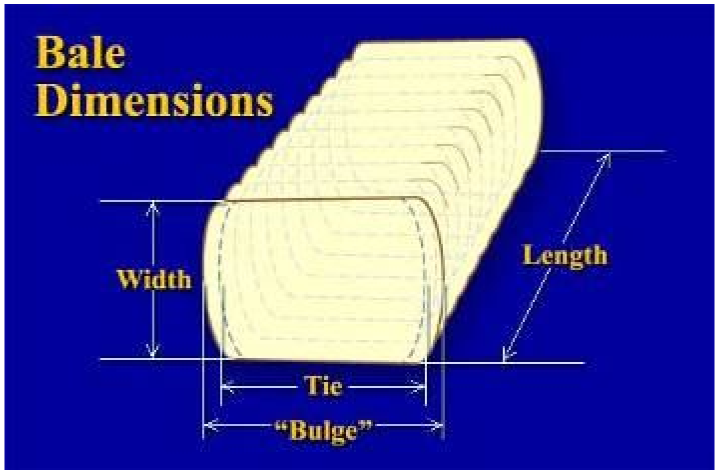
Priority: Recommend not pursuing at this time

Study Team Recommendations for Warehousing

While cotton flows do apparently follow economic principles of least cost, their predictability is complicated by many factors. The flows of cotton to and from cotton warehouses and their underlying economics are as complex as the transportation system with which they are connected. One critical element has been standardized, and that is the cotton bale.

The NCC promotes use of uniform well-protected cotton bales for mill customers. Uniform cotton bales benefit the U.S. industry by maximizing mill processing efficiency, as well as creating efficiencies for storing, handling, transporting and merchandizing. Standard sizes of bales are 55 inches in length, 22 inches in width and the bulge should not exceed 32 inches **(Exhibit 85)**.

Exhibit 85: Standard Bale Dimensions

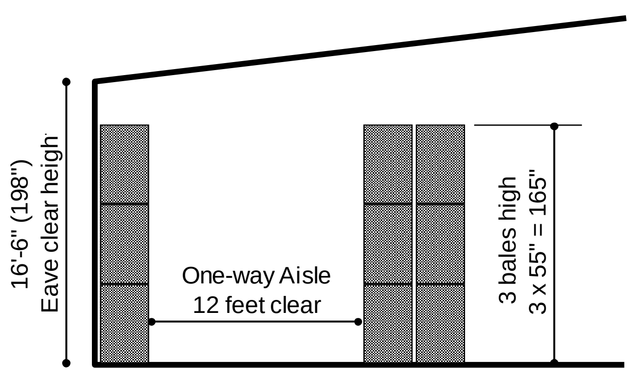


Source: National Cotton Council

Some of the existing country warehouses and consolidation warehouses were constructed to the USDA Public Warehouse Guidelines for storing cotton and will have inside clear heights at the eave lines of approximately 16-foot 6-inches or 198 inches. This recommended specification enabled bale-on-bale stacking in rows 2 bales deep and 1 bale, or 2 or 3 bales high. Three bale levels high would be 165 inches in height (**Exhibit 86**). The size of the crop usually dictates the number of layers in the block. For a small crop only one layer might be needed. For a large crop, two layers could be used. Block stacks of three layers high are very inefficient if the requests for bales on a shipping order are for lower level bales. Shipping orders containing bales on the first layer or from interior rows in a block result in slow bale retrieval rates. This is due to the un-stacking and re-stacking of bales.

Suggested aisle width for a 4 bale clamp fork lift was 12-feet clear for one-way traffic and 24-feet clear for two-way traffic.

Exhibit 86: USDA Suggested Warehouse Profile with 3 Levels of Block Stacking



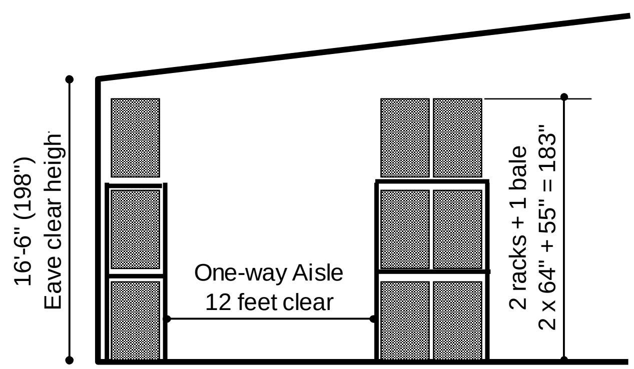
Source: Prepared by Wilbur Smith Associates

Since access to bales on the bottom level in the back row can require considerable un-stacking and later, re-stacking if large blocks are not selected, an NCC affiliated test facility can investigate alternative storage configurations and methods employed in different size warehouses in different cotton regions to evaluate ways of improving warehouse efficiencies.

Warehousing 9: Investigate alternatives for bale storage (racking)

Employing storage racks would eliminate the need to remove upper levels of bales to access lower bales. With a racking system, lower bales could be pulled without the need to move bales above. If the bales are in the rear row, only the front row needs to be moved. A plywood decked racking system would add about 5 inches in height per layer for the steel support beams. Four inches of clear vertical height is necessary to allow lifting the bales slightly for in and out access. The spacing for the two rack levels would be 64 inches plus 55 inches for the top bale. Three levels of racking would require 183 inches in height, which would fit within the eave clear height of 198 inches if the warehouse had been constructed to the USDA recommended standards **(Exhibit 87)**. This means that many of the existing older country and consolidation warehouse compartments could be fitted with racking systems to improve labor efficiency. Also, the floor must be capable of supporting the concentrated loads under the racking posts.

Exhibit 87: Clear Height Required For 3 Levels of Vertical Racking



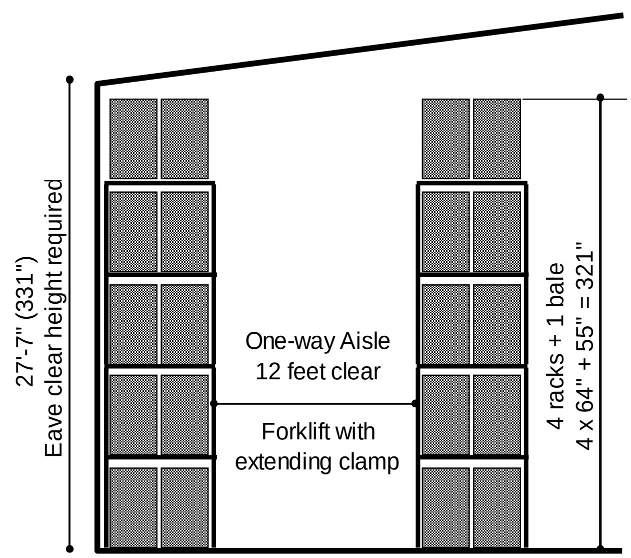
Source: Prepared by Wilbur Smith Associates

However there is a cost for the racking system which may make the transition from block stacking to racking economically unfeasible for many existing smaller country warehouses. Around 75 percent of cotton shipments originate from warehouses that turn their cotton once a year. These facilities do not earn revenue from multiple in/out charges. Thus the racking system would not repeat dividends for them because: 1) one turnover per year does not require an investment to increase inventory velocity (around 2 percent of annual inventory would be shipped per week), and 2) if they are not increasing revenue from inventory touches, they will not generate cash-flow to pay off the investment in the racking system. In reality, in a smaller warehouse that has a minimum shipping velocity and only a skeleton year-round labor crew, labor efficiency gains could contribute to unproductive idle time between busy times.

Suppliers of racking often offer new and used racking systems as a means of economizing. A flexible racking system should be considered because alternative commodities could be stored to generate revenue in other sections of the warehouse when not occupied by cotton. As an order of magnitude estimate, the typical pallet rack costs somewhere in the order of $50 to $70 per pallet position. If cotton racks were to cost within a similar range, and the equivalent of four bales would fit into the equivalent space of a single pallet position, the investment cost per bale would be $12.50 to $17.50. If the racks saved $1.50 per bale per year by enabling warehouses to maintain almost the same density as block stacking while enjoying the accessibility of row stacking, the payback period would be between 8 and 12 years. Given these economics, a major focus of study would be to find a least expensive option for cotton warehouse racks.

If a new cotton warehouse is intended to be a higher velocity facility, built for consolidating and rapid handling of cotton, it could be constructed to accommodate more racking levels. A clear height of at least 27-feet 7-inches would be required at the eave line for 5 levels of vertical racking **(Exhibit 88)**. Modern forklifts can pick inventory at heights of 40 feet. This implies that possibly 7 levels of vertical racking could be used.

Exhibit 88: Warehouse Profile with 5 Bale Vertical Racking

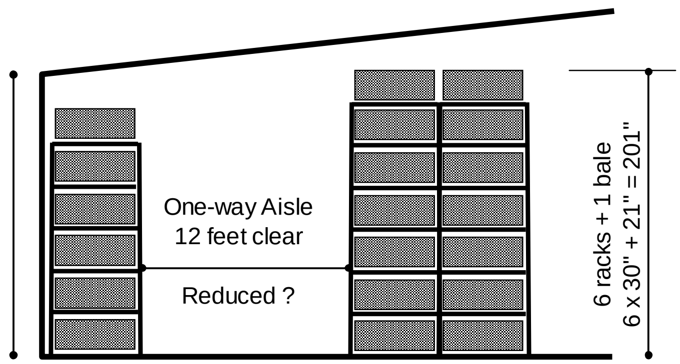


Source: Prepared by Wilbur Smith Associates

If a new warehouse is to be constructed, modern racking and equipment considerations could be incorporated into the design to increase density and improve labor efficiency at higher velocity levels.

Racking configurations for horizontal placement of bales would require the shelf-to-shelf spacing to be approximately 30 inches. This would accommodate the 21-inch flat dimension, 5 inches for the shelving structure and 4 inches for clearance to insert and pull the bales without damaging the plastic wrap. Six levels of racking would require 180 inches in height. A level of bales could be placed on the top shelf which would require 21 inches additional height. The total for this would be 201 inches in height **(Exhibit 89)**. Racking along the walls of a warehouse with 198 inch eave heights would accommodate 6 bale levels, while internal rack could accommodate 7 levels of racking as the clear height under the roof increased due to the roof's slope. The racks would be front loaded.

Exhibit 89: Wide Aisle Profile with 7 Levels Horizontal Racking

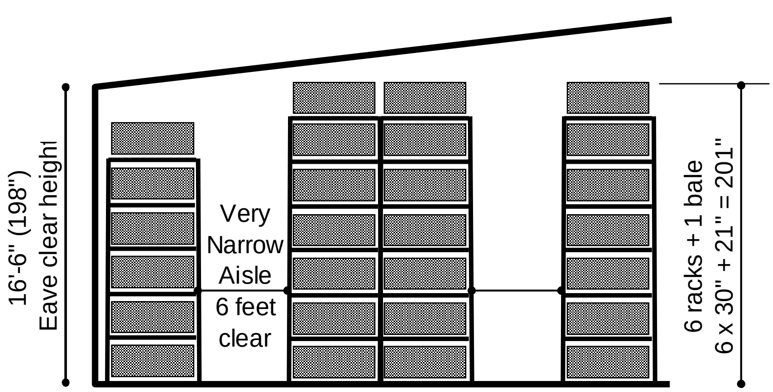


Source: Prepared by Wilbur Smith Associates

Horizontal racking would accommodate fewer bales than vertical racking or vertical stacking. With horizontal racking, the stack would accommodate 7 bale levels in height, one row deep. Vertical bale-on-bale stacking in the more traditional layout, will accommodate 3 bale levels in height, but two rows deep for 6 bales but will also be very inefficient to reach bottom level bales in the back row.

Depending on the layout of the narrower aisles in the warehouse, an additional row or more of bales could be included in the width of the warehouse to increase storage density **(Exhibit 90)**.

Exhibit 90: Horizontal Racking with Very Narrow Aisles



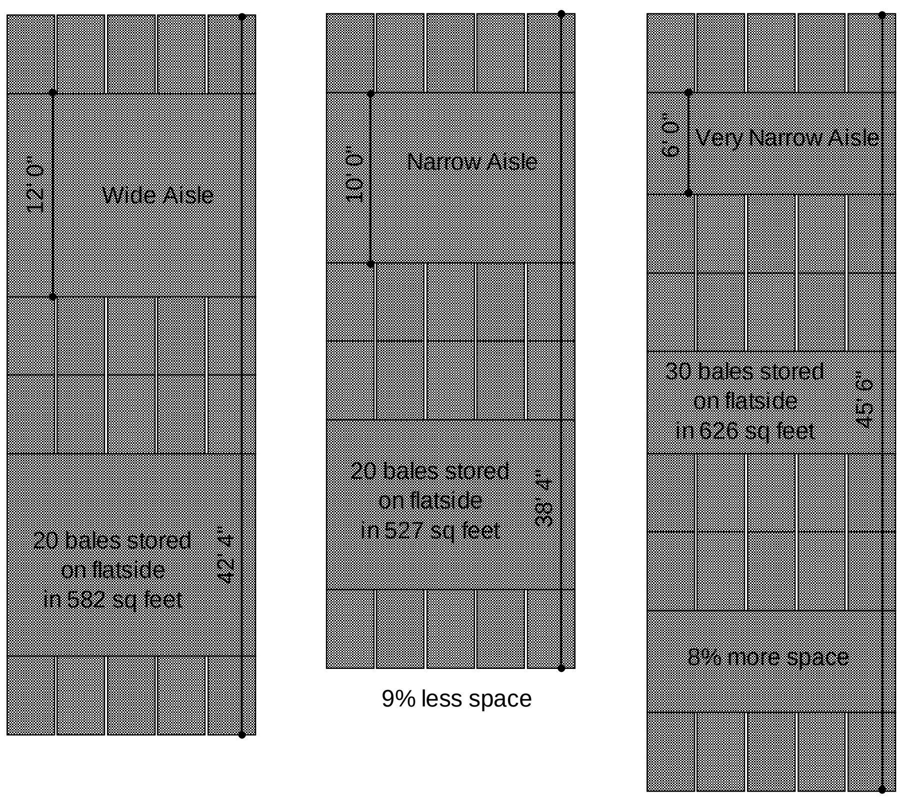
Source: Prepared by Wilbur Smith Associates

The above equipment schematics are intended to initiate new ideas. The layout options for warehouses will require time and motion studies to determine:

- Precise dimensions needed for rack heights and aisle widths;
- Labor efficiencies that can be gained from ease of handling;
- Bagging coefficient of friction for smooth bale sliding to avoid abrasive damage to bale sides when bales are slid into the slots; and
- Other issues that can arise before the introduction of new processes.

Three aisle configurations are now standard: the traditional wide aisle at 12-feet, narrow aisles at 10-feet and very narrow aisles at 6-feet or less. Narrow aisles save space but do not substantially increase storage capacity. Very narrow aisles have the potential for a 50 percent increase in storage capacity with only an 8 percent increase in space used **(Exhibit 91)**. The very narrow aisle configuration is more practical for new warehouse construction due to floor loading and a requirement for a more level floor slab to ensure the racks are truly vertical and do not topple.

Exhibit 91: Plan of Horizontal Bale Racking With Wide, Narrow and Very Narrow Aisles



Source: Prepared by Wilbur Smith Associates

Conclusion - This is just one type of study that could be conducted by the proposed NCC affiliated test facility to determine the practical implications of new integrated systems, processes and practices for the industry before implementation.

Warehousing 10: Explore equipment innovations

Forklifts with taller lifting masts and with horizontal extending clamps would be required to reach into the second row **(Exhibit 92)**. This configuration may require modification of such a forklift for cotton bales, but they are not uncommon in many other industries. With a swivel mast and extending clamp, the aisle width can be reduced to less than 12-feet.

Exhibit 92: Very Narrow Aisle, Side Pick Forklift

Source: Prepared by Wilbur Smith Associates

Narrow aisle and very narrow aisle forklifts with swivel masts and vertical clamps that can pick up bales from either side are already in use in cotton warehouses **(Exhibit 93)**. Because the machines can pick from the side, the aisles can be reduced to the width of the forklift truck, which is usually 6 feet or less. A forklift equipped with a swivel mast and vertical clamp moves down an aisle between rows until the driver locates the bale to be pulled. The mast on the front of the truck is raised up and then lowered down to surround and clamp the bale to be lifted. After lifting, the mast is rotated 90 degrees to move along the aisle to a stacking location.

Exhibit 93: Forklift with Swivel Mast and Vertical Clamp

Source: Cascade Corporation
http://www.cascorp.com/americas/en/layerpicker

Another method to consider for selecting bales would be use of rubber tire shuttle lift cranes **(Exhibit 94)** that could straddle multiple rows plucking bales from blocks similar to overhead cranes used for lifting containers on/off of containerships. In this application, each bale would have a unique bale located code so the picker could use electronic antennae and positioning equipment to guide the selection. An NCC affiliated test facility could establish a project to research the best layout patterns, and work with equipment manufacturers to design and test the prototype equipment.

Exhibit 94: Shuttle Lift

Source: Prepared by Wilbur Smith Associates

Another innovation in use by row stackers are forklifts that remove bales from stacked rows with an attachment called a "rhino horn" or hook on an articulated mast in place of a bale clamp **(Exhibit 95)**. After the bale is located, the horn is rotated to the right or left. A hydraulic cylinder is actuated and the horn pierces the bale so that it can be pulled from its position in the row. Once the bale is extracted it is moved to the center aisle and the next bale can be retrieved.

Exhibit 95: Rhino Horn

Container loaders can be utilized at high velocity warehouses to increase loading efficiency. The machines utilize a hydraulic or mechanical piston to push stacked freight into 40-foot and 45-foot containers **(Exhibit 96)**. The freight can vary from palletized boxes, bales of cotton up to and including stacked logs up to 55,000 pounds in weight. For cotton, the appeal is that the bales can be easily and quickly placed into the loading position prior to the container being backed up to the loading dock. This makes placing the horizontal row of bales on the top level less labor intensive, quicker, and safer. After the load is stacked in the staging area, it is easily pushed into the container in less than 5 minutes.

Exhibit 96: Automated Container Loader

Source: Container Stuffers, LLC. All Rights Reserved.
http://www.containerstuffers.com/C-Loader.html

Recommendations Regarding Shipping

Exhibit 97 contains a series of issues and solutions that have been identified by the study team regarding cotton transportation.

Exhibit 97: Transportation Issues, Proposed and Preferred Solutions

Issue	Preferred Solution
Cotton shippers sometimes have difficulty securing containers for export	The industry could consider stuffing facilities closer to ports, perhaps prepositioning bales in Asia. Prepositioned bales could be moved to container stuffing facilities by boxcar or other inexpensive transportation options.
Cotton shippers sometimes have difficulty securing truck equipment in rural areas	One potential solution would be to implement a series of core carrier programs, whereby shippers guarantee carriers a certain amount of business in return for better rates and more reliable service.
Cotton warehouses are often located long distances from intermodal rail ramps, thus necessitating long drays in order to use intermodal rail service	Advocate for local intermodal ramps, perhaps teaming with other agricultural shippers, as well as investigating potential companies that could generate inbound volumes to counteract outbound imbalance
Shippers could save money by using high cube containers to ship cotton, but containers may exceed roadway weight limits	Establish container stuffing facilities adjacent to ports or intermodal facilities

Shipping 1: Use of standard container sizes

The size of the most common international shipping container is 40-foot in length x 8-feet wide and 8-feet 6-inches high. The inside clear dimensions are critical for bale loading. As important is the clear height of the door to enable maneuvering the last row of upper level bales. As the bales are rigid and cannot bend, if the clearance is too tight, the bales cannot be loaded. The containers have corner posts and lifting couples that protrude into the interior space. Clearance sizes vary by manufacturer. Some can extend too far into the container's interior clear space and can hinder maximum loading.

The standard 40-foot container is the most abundant in service and typically is the size used to ship not only cotton but most international commodities. Most import commodities from Asia arrive in 40-foot containers. However, there are several other container sizes that are used for imports **(Exhibit 98)**. These are an additional foot in height to afford loading of bulkier freight and are labeled high-cube containers. Since these containers must be returned to Asia for loading with more U.S. bound freight, the backhaul to Asia creates an opportunity to take advantage of the additional clear height inside the containers. The high cube containers are available in 20-foot, 40-foot and 45-foot container sizes. However, the 20-foot container is typically not used for cotton bale loading.

Exhibit 98: ISO Container Sizes

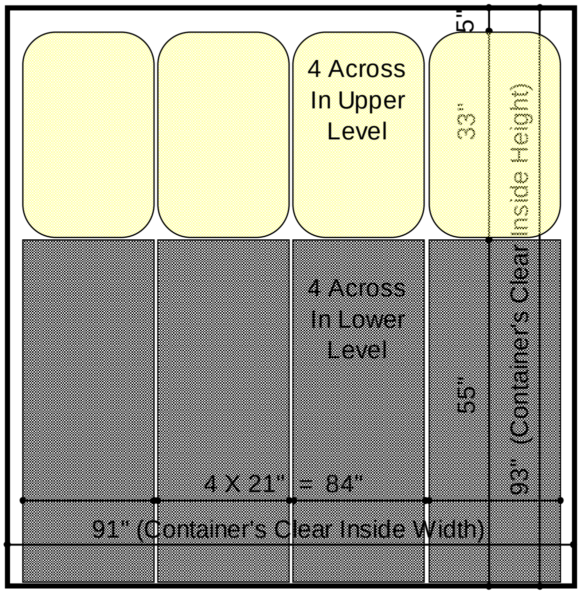
	Container Size		
Dimension	40-Foot	40-Foot High Cube	45-Foot High Cube
External Length	40'-0"	40'-0"	45'-0"
External Width	8'-0"	8'-0"	8'-0"
External Height	8'-6"	9'-6"	9'-6"
Internal Length	39'-4" (472")	39'-4" (472")	44'-4" (532")
Internal Width	7'-7" (91")	7'-7" (91")	7'-7" (91")
Internal Height	7'-9" (93")	8'-9" (105")	8'-9" (105")
Clear Door Height	7'-5" (89")	8'-5" (101")	8'-5" (101")
Gross Vehicle Wt	80,000 lb	80,000 lb	80,000 lb
Truck Tare Wt	27,180 lb	27,180 lb	27,180 lb
Container Gross Wt	67,200 lb	67,200 lb	67,200 lb
Container Tare Wt	8,820 lb	9,260 lb	10,580 lb
Max Container Wt	58,380 lb	57,940 lb	56,620 lb
Max Cargo Wt (Street Legal)	44,000 lb	43,560 lb	42,240 lb

Source: Prepared by Wilbur Smith Associates

Shipping 2: Standardize bale loading in 40-foot containers

Bale arrangement in 40-foot standard containers allows for 88 bales (running 500 lb bales) to be placed in the container. A standard container's clear internal width measurement is 7-foot 7-inches (91 inches). At 21 inches wide, four bales can be stacked across the width of a container. A standard container's clear internal height measurement is 7-foot 9-inches (93 inches). With this clear height a 55 inch bale can be stacked in the lower position with a bale stacked on top of it in the bulge placement at 33 inches high **(Exhibit 99)**.

Exhibit 99: 40-Foot Standard Container - Vertical Stacking

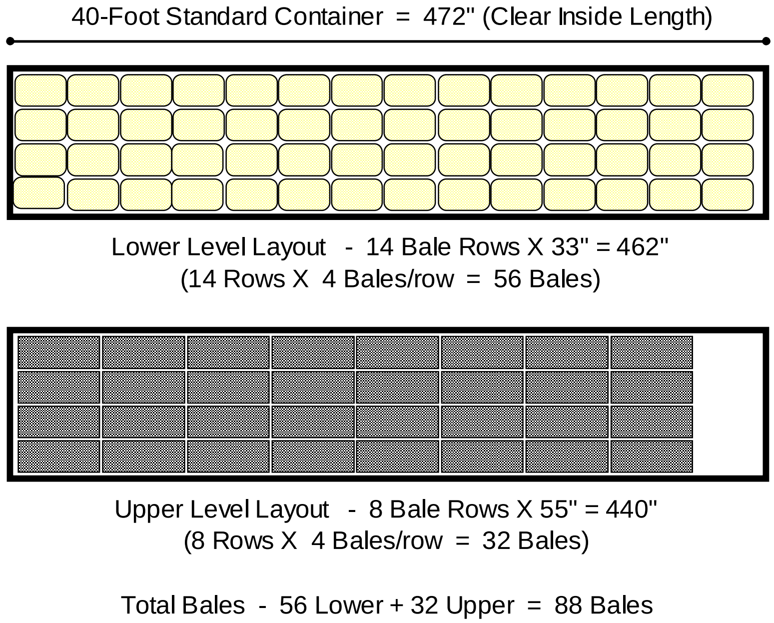


Source: Prepared by Wilbur Smith Associates

The inside clear length of a 40-foot container is 39-feet 4-inches or 472-inches **(Exhibit 100)**. This allows for 14 rows of bales to be stacked vertically inside in the lower level. Each row would be 4 bales wide. The number of bales in the lower level would be 56 (14 x 4). On the upper level the bales would be arranged horizontally in 8 lengthwise rows. This allows 32 bales to be put into the container (8 x 4). The total bales in the 40-foot standard container would be 56 + 32 = 88. This has become the standard configuration for exporting cotton bales.

With 88 bales at 500 pounds per bale the weight would total 44,000 pounds which is within the limitations for carrying the container on all U.S. highways.

Exhibit 100: 40-Foot Standard Container - Horizontal Layout

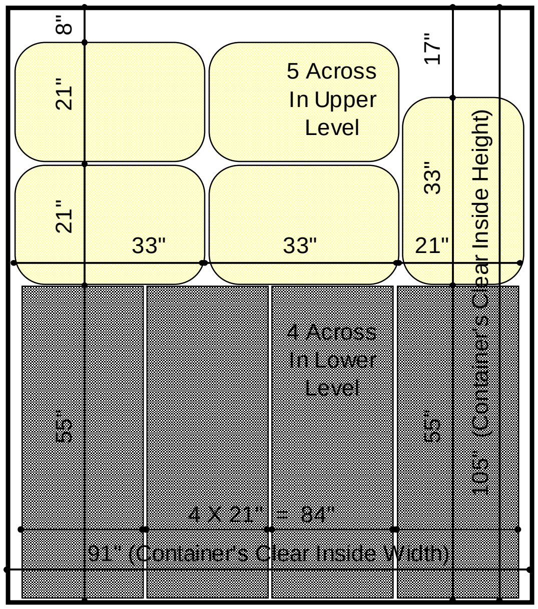


Source: Prepared by Wilbur Smith Associates

Shipping 3: Standardize bale loading in 40-foot high cube containers

The 40-foot high cube container's additional clear height allows for stacking the upper level of two levels of bales in a modified lance position (head first with the crown or round side of the bale perpendicular to the side wall) **(Exhibit 101)**. The arrangement allows enough space for an additional bale to be inserted across the length of the container in the lance position. Loading the bales in high-cube containers can be more labor intensive; however, container loading teams are becoming more efficient with the process.

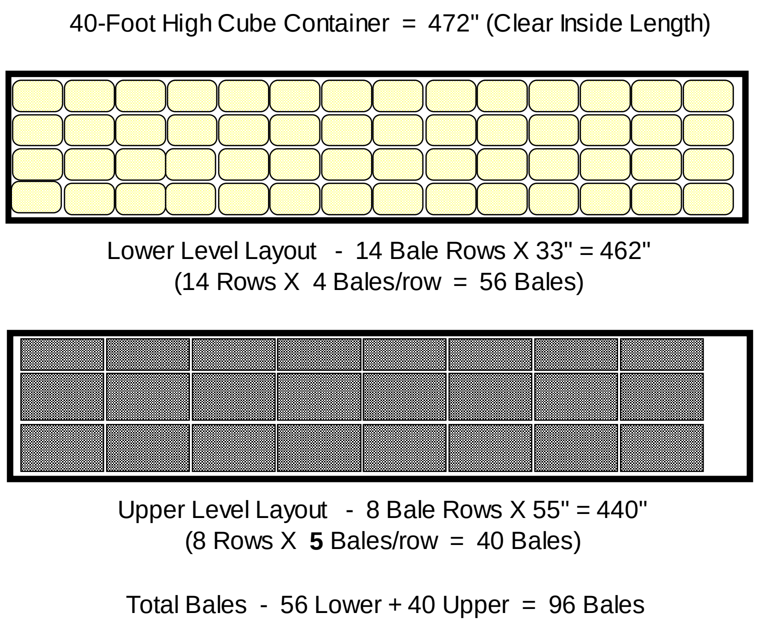
Exhibit 101: 40-Foot High Cube Container - Vertical Stacking



Source: Prepared by Wilbur Smith Associates

Similar to the 40-foot standard container, there is no change in the configuration of how many rows can be placed into the container on either the lower or upper levels **(Exhibit 102)**. The increased volume comes from the one additional lance position bale per row that can be placed into the upper level. Pre-stacking the bales in a staging area and pushing them directly into a container with an automated container loader **(Exhibit 96)** instead of carrying bales into a container using a clamp truck would simplify loading bales into any container.

Exhibit 102: 40-Foot High Cube Container - Horizontal Layout



Source: Prepared by Wilbur Smith Associates

The upper level rows would contain the equivalent of 5 bales across. The bale count in the upper level would be 8 rows times 5 bales per row or 40 bales total. That is 8 more than the standard 40-Foot container or a 9 percent increase in bales shipped. For loading efficiency, the upper level of bales could be bound in plastic wrapping to keep them together. The NCC test facility could investigate the most efficient means of securing and loading the container.

The benefit is apparent when large numbers of bales are shipped. Using a 10,000 bale shipment to Asia for example, with 40-foot standard height containers, 114 would be needed. Using high cube 40-foot containers, 104 containers would be needed. Thus there would be 10 fewer containers required. This would reduce costs for container stuffing, drayage, rail transport, harbor drayage, vessel transport, documentation, customs clearance, and most other processing charges. However, these are not a direct off-set in charges and money saved. High cube containers are not always available and may require a premium to obtain a unit for use and transport.

Shipping 4: Develop chassis pools to move heavier container weights on U.S. Highways

An important factor limiting utilization of high cube containers is current federal law limiting gross vehicle weight to 80,000 pounds. Most ISO 40-foot and 45-foot containers can carry 56,000 to 58,000 pounds, respectively. However, in the U.S. the legal net weight that can be carried in a container on most roads is around 45,000 pounds depending on the tare weight of the empty container, truck and chassis. Special over-weight permits are required to pull heavy containers on highways. An over-weight permit adds cost to the transport that can range from $115 to $250 per drayage. Special three-axle chassis may also be required to spread the weight over more road surface. Renting the special chassis may also add $100 or more to the transport. Additional miles may also be added to dray transport as the heavier loads are routed away from bridges that cannot support the heavy weight.

A 40-foot standard container with 88 running bales weights approximately 44,000 pounds (88 x 500 lb bales). A 40-foot high cube container with 96 bales weights about 48,000 pounds (96 x 500). To avoid the overweight permit, the standard high cube container should carry around 87 bales with a total weight of 43,500 (actual number of bales will depend on the combined weight of the container, chassis and cotton). The extra container tare weight produces a lower street legal loaded cargo weight. The loading of 87 bales in high cube containers would require one additional (114 + 1=115) container to ship 10,000 bales to Asia. A review of tare weights for 45-foot long high cube containers reveals that only 84 bales could be loaded legally. This issue will also be discussed in the next section.

To move an over-weight container, a chassis capable of carrying the weight is required. These chassis usually have three axles to spread the weight over a greater amount of road surface.

Many of the heavy-weight chassis are extendable; they can be shortened move a 20-foot container or stretched to accommodate a 40-foot or 45-foot container. These chassis are more expensive and are usually limited in availability. This is particularly true in rural areas such as the cotton producing and shipping regions. There are two issues with equipment availability for intermodal transportation. The most obvious is access to an empty container so it can be loaded. But more important, is access to a chassis that can move the container. Without a chassis, even if a container is available, it cannot be transported between the rail terminal and warehouse.

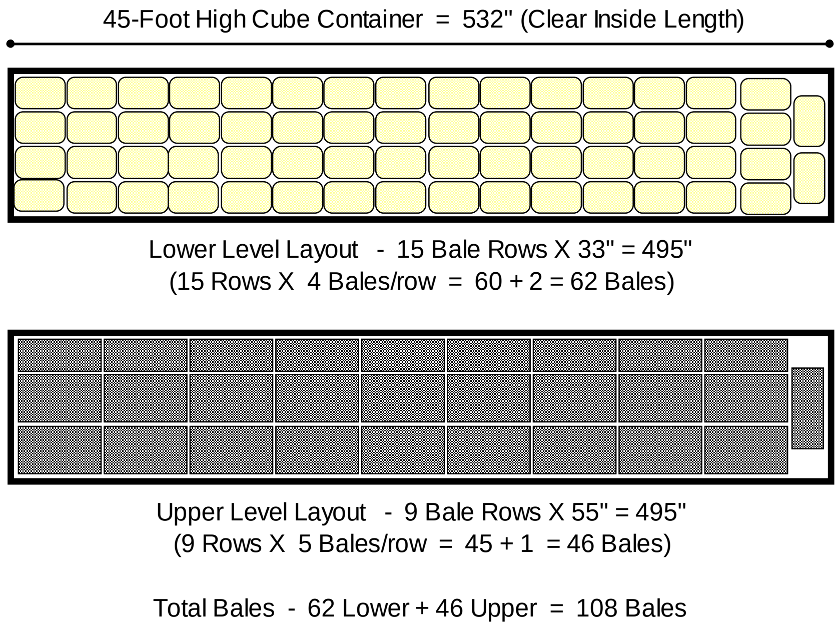
It is recommended that the cotton industry investigate the feasibility of purchasing a suitable amount of overweight chassis to establish dedicated chassis pools in appropriate locations that can be leased to cotton shippers in time of need. By owning the pool of chassis, or participating in a chassis sharing program with other industries, cotton shippers could control chassis use to insure cotton loaded containers are transportable when needed. At times of the year when cotton transport demand is slack, these chassis could be leased to other industrial sectors that require heavy haul chassis.

Shipping 5: Standardize bale loading in 45-foot high cube containers

The 45-foot high cube container's additional inside height allows for stacking the upper level of bales with the bulge side flat, two levels high (**Exhibit 99**), the same as in a 40-foot high cube container. The arrangement allows enough space for an additional bale to be inserted across the width of the container.

Additional carrying capacity is due to the longer length of the 45-foot container (**Exhibit 101**). A 45-foot container's clear internal length is 44-feet 4-inches or 532 inches. The actual dimension can vary depending on manufacturer. The additional length allows for 15 rows of bales to be stacked vertically inside in the lower level. Each row would be 4 bales wide. The number of bales in the lower level would be 60 (15 x 4). On the upper level, the bales would be arranged horizontally in 9 lengthwise rows. This will allow another 45 bales to be put into the container (9 x 5). The total bales in the 45-foot high cube container would be 60 + 45 = 105. Stacking the bales in a staging area and pushing them into a container with an automated container loader **(Exhibit 103)** will simplify loading the bales into the container. There is space between the last row of bales and the door to vertically insert 2 bales in the lower level and 1 bale horizontally in the upper level. If these bale configurations can be accommodated it will bring the total bales to 108 in a 45-foot high cube container.

Exhibit 103: 45-Foot High Cube Container - Horizontal Layout



Source: Prepared by Wilbur Smith Associates

Returning to the example for a 10,000 bale shipment to Asia, with 40-foot standard height containers, 114 containers would be needed **(Exhibit 104)**. Using 45-foot high cube containers, only 93 containers would be needed. Thus there would be 21 fewer containers to move the bales. There could be significant savings generated by the reduced number of cost components.

Exhibit 104: Comparison of Container Loading Capacity

Container Size	Bales	Weight	Containers required to deliver 10,000 bales	Percent Container Reduction
40-foot standard	88	44,000	114	
40-foot high cube	96	48,000	104	8.8%
40-foot high cube (street legal)	87	43,500	115	-0.9%
45-foot high cube	108	54,000	93	18.4%

Source: Prepared by Wilbur Smith Associates

There are two major constraints to using the 45-foot high cube containers. First, they are limited in supply; which means if, when and where an empty unit is available, the lease price could be escalated by other shippers bidding up the rate in an effort to secure it for their own use.

Second is the overweight issue. With 108 bales on board, the weight of the loaded container will be 54,000 pounds, plus approximately 1,000 pound of weight of the larger sized container. This is definitely above the 44,000 pound range for street loading. There is no reason to reduce the number of bales loaded into a 45-foot high cube container to be below the 44,000 pound range as that can be accomplished by using a 40-foot high cube container. An overweight permit will be required for every container that would use public highways to reach a port/ship loading area. Permits may range in cost from a low of $15 up to $60 or even more if a fee is applied depending on the state, weight range and duration of the permit. Special chassis to carry the additional weight may cost an additional $100 to $200 or more depending on the location, availability and duration of use. There is a potential for addition savings. With fewer containers shipped, there are fewer APHIS inspections and other documentation fees which can cost $75 or more per container.

Shipping 6: Develop specialized container loading facilities

An alternative to loading high cube containers at existing warehouses that would exceed weight limits and require an overweight permit for transport on public highways is to load the containers at a transload facility in a rail terminal or at a port/ship loading area. This would eliminate the need to travel over public highways that have weight restrictions. Cotton bales could be transloaded from trucks directly into the high cube containers. A basic premise of a transload facility is that the "bales do not touch the floor." Better stated, bales are not stored in a transload facility (held for a maximum of couple of days). The purpose of the transload is to insure loading of bales into a specific container headed to the correct destination. In this case, bales of cotton would be off-loaded from the delivery truck, taken to a staging area and loaded directly into a waiting outbound container. An automated container loader is a perfect application for this activity and would speed up the velocity of cotton moving through the facility.

At a rail terminal, the loaded high cube, the heavier container would remain on the railroad's property to be loaded onto an intermodal railcar. The intermodal railcar would be in a train that terminates at a port and not a rail terminal that would require public highway transit to a port (which would require an additional dray cost and overweight permit).

At a port, the loaded high cube, heavier container would be moved alongside a vessel for loading and would not travel on public highways. Whether the container is transloaded at a rail terminal or port, the transloading will need to be performed in a secure area.

This type of transloading is in early use several port locations and intermodal points such as the Canadian National's Memphis terminal. It provides rail access to Prince Rupert, which has on-dock loading capability. The containers do not travel on any public highways. Should the service prove successful, other on-site transload facilities could be arranged at the major railheads.

Shipping 7: Maximize savings by loading high cube containers at specialized container loading facilities to reduce number of containers shipped

To reduce transportation costs it is recommended to combine the increased loading capacity from using 45-foot high cube containers with the avoidance of over-weight transport by loading the containers at specialized loading facilities. Savings are produced from transporting fewer containers and the associated documentation and administrative costs.

At this time, with container volumes decreased and fuel costs gyrating, it is somewhat difficult to accurately predict in the near and longer term what the cost of shipping a container to Asia will be. For estimating purposes, assume the cost will be approximately $1,600 per container. There could be a 10 percent premium for access to high cube equipment, so the container cost could be $1,750. Assume overweight handling and permit fees net out with reduced APHIS and other documentation costs. The cost impact of fuel price changes and surcharges are not included in the following estimates.

In the 10,000 bale example, the following savings could be estimated **(Exhibit 105)**. The estimate is presented for an order of magnitude comparison. The estimate can and will vary depending on the actual shipping point, the time of the year, availability of equipment, regulatory fees for overweight transportation, size of shipment, fuel costs, and other potential charges. The intent is to demonstrate that using alternative container sizes can generate savings for the cotton industry.

Four scenarios are presented:

- 40-foot standard container with 88 bales loaded to 44,000 lbs – base case;
- 40-foot high cube container with 87 bales loaded to 43,500 lbs – street legal;
- 40-foot high cube container with 96 bales loaded to 48,000 lbs – requires overweight permit; and
- 45-foot high cube container loaded with 108 bales to 54,000 lbs – requires overweight permit.

It is assumed that each inbound truckload into the transload facility would carry 88 bales. Transloading costs vary by location, type of facility, seasonality, etc. and can range from $150 to $200 which would be applied to each inbound truckload. An average of $175 per inbound truckload was used for this model. A sensitivity test for an upper and lower range is described below. In the first two scenarios, there is no need for transloading as the containers are street legal and do not require overweight permits or heavy chassis drayage. In the third scenario, the cost of transloading from the inbound trucks into 40-foot high cube containers exceeds the savings and thus is not an economical solution. In the fourth scenario, the savings from transporting fewer containers is greater than the transloading cost. This makes it an economical solution. On 10,000 bales, savings of approximately $1.68 per bale could potentially be realized.

A sensitivity analysis on the 45-foot high cube containers indicates:

- Transload cost at $150 per inbound truckload yields $1.97 savings per bale;
- Transload cost at $200 per inbound truckload yields $1.40 savings per bale; and;
- Transload cost at $230 per inbound truckload yields $1.05 savings per bale.

Exhibit 105: Potential Savings from Use of High Cube Equipment

Container Size	Containers Required	Containers Saved	Savings Per Container	Group Savings	Transload Cost @ $175 per Inbound Truck	Savings After Transload Cost	Savings Per Bale
40-foot Standard container (88 bales, 44,000 lbs.)	114						
40-foot street legal high cube container (87 bales, 43,500 lbs.)	115	-1	-$1,750	-$1,750		-$1,750	-$0.18
40-foot high cube container (96 bales, 48,000 lbs.)	104	10	$1,750	$17,500	$19,950	($2,450)	-$0.25
45-foot high cube container (108 bales, 54,000 lbs.)	93	21	$1,750	$36,750	$19,950	$16,800	$1.68

Source: Prepared by Wilbur Smith Associates

It is interesting to note that loading 40-foot high cube containers with only 87 bales, the street legal limit, actually increases the number of containers per shipment by one and produces a loss of $0.18 per bale. Thus, transloading 40-foot high cube containers at interior warehouses are currently not a viable option.

Shipping 8: Advocacy for intermodal access to equipment and terminals

Particularly in the East, intermodal rail transportation has become more often a matter of public/private partnerships. The trend began with Norfolk Southern Corporation's (NS) Heartland Corridor project. This project was funded by the federal government, NS, and the states of Virginia and Ohio. It includes modifications to the NS rail line between Norfolk, VA, and Columbus, OH, to clear obstructions that would otherwise hinder the usage of double stack intermodal trains. NS has also constructed a new intermodal facility in Columbus, OH. NS has offered to serve intermodal terminals in Prichard, WV, and Roanoke, VA. Most of the cost of construction would be funded by public agencies. The Roanoke and Prichard facilities are currently in the planning stages. CSX Transportation has followed suit, proposing its own *public/private initiative, the National Gateway Corridors initiative. Similarly, this will involve rail line clearance projects and additional intermodal facilities along the following corridors:*

- I-95 Corridor between North Carolina and Baltimore, MD, via Washington, DC;
- I-70/I-76 Corridor between Washington, DC, and northwest Ohio via Pittsburgh, PA; and
- Carolina Corridor between Wilmington, NC, and Charlotte, NC.

The Ohio Soybean Council believes that a new intermodal facility constructed in North Baltimore, OH, will benefit its members.

A recent report commissioned by the Texas Department of Transportation entitled *Trans-Texas Corridor Rural Development Opportunities: Ports-to-Plains Case Study*[44] advocated for additional intermodal terminals in West Texas, in part to serve cotton shippers. Although western rail carriers have so far shown greater reluctance than their eastern counterparts to engage in public/private partnerships, these public/private initiatives can be influenced by stakeholders such as the National Cotton Council.

Establishing small scale intermodal facilities that could be used for cotton loading can be accomplished in a relatively short period of time if a rail line exists that has a suitable rail siding alongside the warehouse and if the economics can be arranged with the railroad. There will need to be ample volume to support the investment, preferably year-round business to support a full-time operating crew, and adequate inbound container supplies for reloading containers. It is beyond the scope of this study to determine the specific locations for the outflows and suitability of the economics for the railroads, although Lubbock, TX, was highlighted as a case in point in the Least Cost Model.

[44] Cambridge Systematics for Texas Department of Transportation, *Trans-Texas Corridor Rural Development Opportunities: Ports-to-Plains Case Study*

Conclusion, Summary of Recommendations

During the Cotton Flow Study, the study team did not find a single solution that would radically lower costs and increase revenues associated with cotton flows. The study team found no “silver bullet.” Rather, the study team found a variety of incremental solutions that taken collectively could significantly improve cotton flows. The recommendations proposed in this study fall into several categories:

- Short term recommendations that could be accomplished as part of the NCC’s ongoing activities;
- Medium term recommendations that could be accomplished by the NCC and its members in a relatively straight-forward manner. Medium term recommendations would require the buy-in of stakeholders such as the USDA, NCC members, and members of allied industries;
- Long-term projects that have significant potential to improve cotton flows. The identified long-term projects would require additional study along with buy-in from stakeholders; and
- Long-term projects that are worth considering but would best be monitored rather than acted-upon in the short-term.

A consolidated listing of these projects is provided in **Exhibit 106**. These are provided in order of priority ranking as assigned by the study team.

Exhibit 106: Recommendation Summary

Recommendation	Recommendation Category
Data Systems 3: Encourage better use of existing e-commerce tools. Offer classes and seminars similar to the gin schools for personnel involved in cotton flow data management	1) Short term project, part of ongoing activities
Data Systems 6: Establish holdership query protocols for unclaimed or damaged bales	1) Short term project, part of ongoing activities
Warehousing 5: Encourage timely shipment pick-up (honor negotiated load dates) to avoid non-performance penalties	1) Short term project, part of ongoing activities
Merchandizing 1: Encourage usage of existing export credit guarantee programs.	1) Short term project, part of ongoing activities
Shipping 8: Advocate for intermodal facilities located near cotton producing areas	1) Short term project, part of ongoing activities
Warehousing 6: Recommend changes to trade rules so that warehouses can be rewarded for exceptional (expedited) service	1) Short-term requiring stakeholder buy-in
*Merchandizing 5a:*Work with APHIS Plant Protections and Quarantine (PPQ) to ensure that cotton is allowed to use an electronic PPQ form 572 (pre-shipment inspection)	1) Short-term requiring stakeholder buy-in
*Merchandizing 5b:*Encourage all compliant warehouses to provide a shipper or freight forwarder with an electronic 572 at the time of loading	1) Short-term requiring stakeholder buy-in
Merchandizing 5c: Continue to work with APHIS PPQ to expand the negotiations with foreign governments who treat densely packed baled cotton as a regulated article	1) Short-term requiring stakeholder buy-in
Data Systems 4: Add functionality to internet based applications/websites such as “IsMyLoadReady.com” so that shippers, freight forwarders, truck dispatchers, truckers, etc., who need bale or load status information	1) Short-term requiring stakeholder buy-in
Data Systems 4b: Continue to publicize and promote the use of Batch 23 files	1) Short-term requiring stakeholder buy-in
Data Systems 5: Add multiple levels of access to the provider system, without jeopardizing the integrity of electronic receipts; maintaining business confidentiality; and ensuring that data can be viewed but not altered	1) Short-term requiring stakeholder buy-in

Data Systems 7 and 8: Explore basic elements of a universal bale locator code and usefulness of bale location translator	2) Medium-term requiring stakeholder buy-in
Data Systems 2: Explore usage of automatic notifications throughout entire supply chain	2) Medium-term requiring stakeholder buy-in
Data Systems 1: Continue efforts with Cotton Incorporated, shippers, warehousers, mills and others to better coordinate warehouse bale locations with shipping orders that include mill quality needs; consider use of incentives or disincentives to shippers to minimize locations from which bales are pulled	2) Medium-term project with significant potential requiring additional study and stakeholder buy-in
Data Systems 9: Develop "best practices" programs for warehouses with an emphasis on preparing pick lists	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Warehousing 9: Investigate alternate storage methods, including racking systems and geospatial monitoring of bale locations	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Merchandizing 7: Establish alternate cotton supply chains, including low-cost, low value and high-cost, high value	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Merchandizing 2, 3 and 4: Develop pilot program to investigate feasibility of various ST units	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Merchandizing 6a, b, c: Investigate likely costs of USDA classing at gin and establish a pilot program if warranted.	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Shipping 6: Establish container stuffing facilities adjacent to ports or intermodal facilities	3) Long-term project with significant potential requiring additional study and stakeholder buy-in
Warehousing 10: Explore possibility of adapting automated container/van loading and unloading technology	4) Projects to be monitored
Data Systems 10: Continue monitoring RFID and other emerging technologies; explore opportunities to seamlessly integrate other technology based management systems.	4) Projects to be monitored
Merchandizing 8: Encourage direct interaction between foreign buyers and gins/producers	4) Projects to be monitored
Shipping 1 – 4, 5 and 7, and Least Cost Model Scenarios: Various programs to ensure that trucking and container equipment is available when needed and utilized with maximized efficiency	4) Projects to be monitored
Warehousing 1 – 4, 7 and 8:	Recommended not to pursue at this time