

**National Grain Car Council**  
**Evolution of Grain and Transportation**  
**White Paper**  
**July 2011**

The purpose of this paper is to provide a historical context of the Agricultural Industry and its development, interaction and synergistic relationship with rail transportation. Changes that have occurred within each industry over the past several decades have blended together to enhance a transportation system that is an important component of supplying grain to domestic and international locations.

The paper will be divided into three distinct sections as follows.

Section 1: Evolution of the Grain Market

Section 2: Evolution of Railroad Grain Transportation

Section 3: Impact of Technology on Railroad Performance

**Executive Summary**

Supply and demand for grain concurrently influence United States production on an annual basis. However, the historical trend has been that increasing supplies of grain and oilseeds are needed to feed a growing population. More recently, the United States is also experiencing increased demand for renewable fuels. It is reasonable to expect these trends to continue.

Supply factors which have impacted production include changes in planted acres favoring the Northern and Western grain producing states. Improved seed technology has also increased yields dramatically by improving resistance to drought conditions and providing for more efficient use of nitrogen – a trend that is expected to increase at an even greater pace in the future. Mechanization of farming techniques and technology has helped drive farmer productivity. All of these factors combined have increased annual crop production by several billion bushels over the past ten years.

Demand factors have also influenced grain production over the past several decades. Population growth and improved disposable income levels continue to be the primary driver for increased total demand. However, improving diets have led to per capita consumption increases in protein derived from meat, milk and eggs which has had a major impact on the demand for grain and oilseeds. Increased reliance on renewable fuels is a contested and complicated issue but it is a good example of a recent trend that has impacted domestic production of corn, and to a lesser extent, soybeans. Within the next five years the production of corn based ethanol is expected to reach 15 billion

gallons which will equate to the consumption of over 5.2 billion bushels of corn – more than one third of U.S. production. This increased consumption would represent a 1.2 billion bushel increase over the corn consumption for ethanol production in 2010. The growth of supply and increasing demand has created the need for efficiency improvements. This has led to grain elevator consolidation and has also encouraged productivity improvement in transportation.

Supply and demand changes have also led to industry consolidation and changes in shipping patterns. Technological advances have made large scale farming more productive and profitable. As elevator size continued to grow, they migrated towards higher density rail lines which further encouraged the maximization of transportation efficiencies involving unit size, loading speeds, and transit velocity. While this paper focuses on the interrelationship of U.S. grain and oilseeds and rail transportation, it is important to note that trucks now transport more than half of U.S. grain and oilseed movements. Rail accounts for approximately one third and barges about 20 percent of grain movement. Physical access to rail service has become more limited in rural areas with the trend towards large unit-train facilities. This has also led to an increasing concentration of grain handling at fewer loading points, causing the average farm-to-market distance to be longer. Thus, the efficiency gains accruing to rail carriers by moving to larger unit trains has had the impact of putting added traffic on highways and local roads.

As supply and demand factors within the grain industry change, railroad transportation also continues to evolve. The unit train or shuttle concept, defined as a single train greater than 65 cars carrying one commodity, has generated so many efficiencies it is a significant product for rail grain distribution. Locomotive technology, specifically the switch to AC power allows for more tractive effort which enables a railroad to increase unit size without increasing the number of locomotives required to pull the unit. Speed of loading the train has become a significant factor as railroads generally supply an incentive to load or unload a train within 15-24 hours. The consistency of a 15-24 hour load/unload allows for railroads to more precisely plan locomotive and crew resources thereby providing more consistent and reliable transit time. A further benefit of speed and consistency is as equipment turns faster, total grain carrying capacity increases without additional capital investment. However, there is a cost to these programs, as rail shippers and receivers upgrade storage, receiving and handling equipment, and track capability to handle the larger size units.

Technology also plays a growing role in the continuous evolution of railroad performance and capacity. The U.S. Department of Transportation recently reported that freight railroad demand is expected to increase by 88% by 2035, and concluded that \$148 billion must be invested in railroad infrastructure expansion to keep up with anticipated demand. Class I railroads are actively investing in physical infrastructure including track, terminals and fleet capacity, but enhanced technology will also be an increasingly important way to improve rail capacity. Automatic Equipment Identification readers, fuel and travel optimization software and Positive Train Control are a few recent technological advances which will improve safety and reliability while increasing capacity.

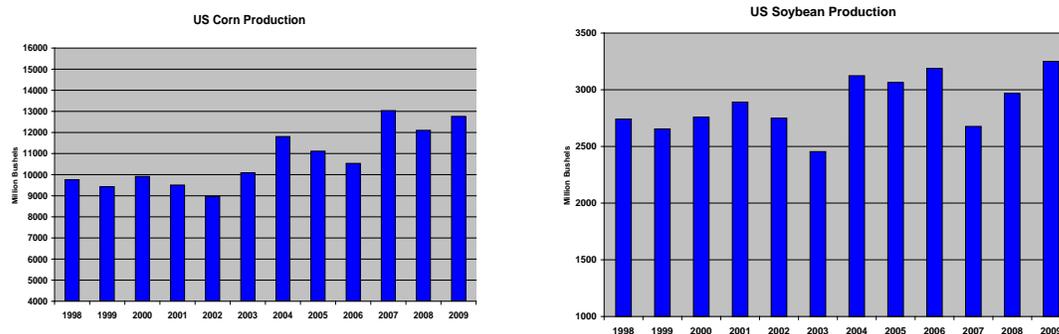
Both the grain industry and railroads have deep rooted histories and inter-relationships. As each industry has evolved the recurring theme seems to be increasing dependence on size, speed, and reliability to satisfy international and domestic customers whose requirements have also continued to evolve. This paper provides some perspective on that evolution and perhaps provides an indication of what the future holds for these industries.

## **Section 1: Evolution of the Grain Market**

Both the supply and demand characteristics of the United States grain market have changed the method and quantity of grain and oilseeds produced over the past twenty years. Supply and demand have influenced change in production and availability not only domestically, but globally as well. This section will focus on factors which have influenced a dynamic changing supply of grain and oilseeds in the United States, and highlight the factors impacting demand.

### **Supply Factors**

The following charts representing corn and soybean production over the past 11 years show a positive trend line with both commodities. Numerous factors have influenced the production increases over the past several decades.



### **Changes in Production Patterns**

Since the middle of the 80's the primary grains, corn and soybeans, have migrated out of the Southeastern United States and expanded beyond traditional Midwestern states of Illinois, Indiana, Ohio, Iowa, Nebraska and Wisconsin to encompass the Northern Plains (Dakotas) and southern plains states of Kansas, Oklahoma and Texas resulting in some cases for grain to travel longer distances to reach potential feed, processing or export markets. In fact, since 1985 corn and bean production in the Southern tiered states has declined 34%.<sup>(1)</sup> Seed technology, fertilizer application, and conducive climate have been the leading contributors to this shift. Technological advances such as genetically modified seed and "Roundup Ready" seeds, have made growing corn in the northern climate more efficient, economical, and have made the yields more consistent. The elimination of farm program restrictions has also increased producer planting flexibility and enabled more natural planting shifts to occur.

## **Seed Technology**

Seed technology continues to evolve as companies research new seeds through breeding and biotechnology that will help farmers produce more grain and conserve more resources. Technology's influence on yields and drought tolerance are expected to continue to improve grain production, with some projections that corn yields could approach 300 bushels per acre in the next decade. Advancements in seeds that use nitrogen more efficiently and seeds that reduce the use of pesticides are also pushing grain yields to new heights. One study done in 2005 by Dr. Graham Brookes and Dr. Peter Barfoot shows that there has been substantial net economic benefits at the farm level amounting to \$5 billion in 2005 and \$27 billion for the ten year period between 1995-2005 as a result of genetically modified crops.<sup>(2)</sup>

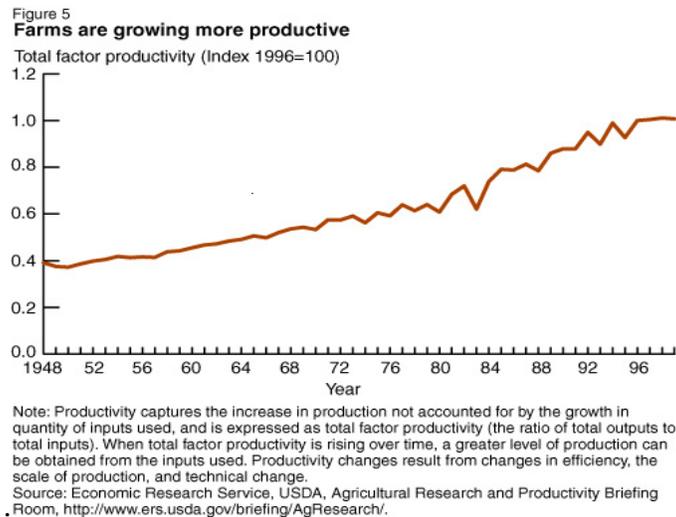
The technology has also reduced pesticide spraying by 224 million kg worldwide and as a result, decreased the environmental impact associated with pesticide use by more than 15%. Genetic Modification technology has also significantly reduced the release of greenhouse gas emissions from agriculture, which, in 2005, was equivalent to removing 4 million cars from the roads.<sup>(3)</sup>

## **Mechanization and Fertilizer Use**

Mechanization in agriculture has also been particularly influential in driving changes to the farm sector. Following World War II, technological developments occurred at an extraordinarily rapid pace.

- Advances in mechanization and increasing availability of chemical inputs led to ever-increasing economies of scale that spurred rapid growth in average farm size, accompanied by an equally rapid decline in the number of farms and in the farm and rural populations. Crop production relies on fertilizers to replace soil nutrients and faster fertilizer application results in faster planting which allows for narrower planting and harvesting windows.
- Farmers also went from complete reliance on animal power in 1900, to rapidly embracing mechanical power. Mechanical harvesting of crops became routine by the late 1960s and tractors had essentially replaced animal power by 1970.
- Advances in plant and animal breeding throughout the century facilitated mechanization and increased yields and quality.

As a result of these advances, growth in agricultural productivity averaged 1.9 percent annually between 1948 and 1999 which positioned the U.S. as a large global supplier of grain.<sup>(4)</sup> Mechanization continued to evolve in the last decade and has allowed for faster application of fertilizers, as well as quicker planting and harvesting of more acres.

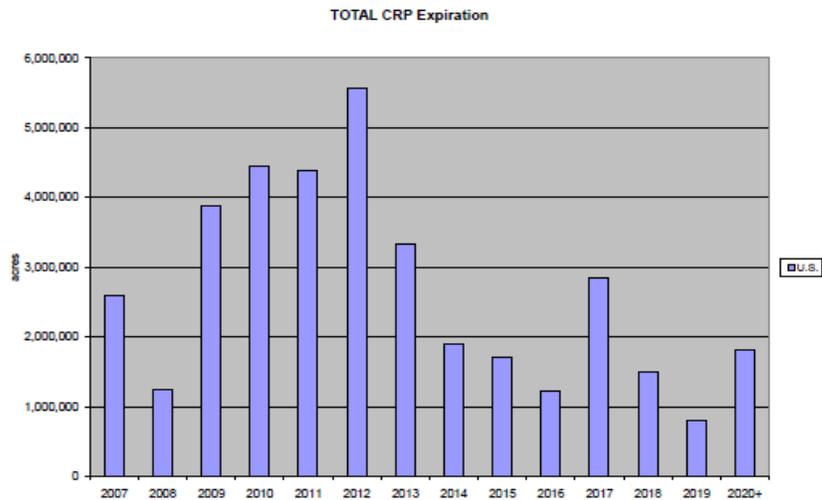


## U.S. Policy Change

- **The Conservation Reserve Program (CRP)** was authorized in the 1985 Farm Act, initially as a way to reduce soil erosion and heavy carry-over supplies of grains and oilseeds. In the ensuing years, the criteria for enrollment of land into CRP gave greater weight to such environmental factors as soil and wind erosion, preservation of water quality and wildlife enhancement. The program allows for agricultural landowners to voluntarily enroll acreage in a 10-15 year contract, through which they would receive assistance technically and financially in addressing soil, water, and related natural resource concerns on their land in an environmentally beneficial manner.

The program is funded through the Commodity Credit Corporation (CCC) which provides annual rental payments based on the agriculture rental value of the land, and cost-share assistance for up to 50 percent of the participant's costs in establishing approved conservation practices. The CRP reduces soil erosion, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat and enhances forest and wetland resources. The program also encourages farmers to convert environmentally sensitive cropland to vegetative cover. The CRP continues to be a major contributor to increased wildlife populations in many parts of the country.

- One provision in the **2008 Farm Act**, beginning in October 2009, was to reduce the maximum cap to 32 million acres which is an 18% reduction of the 39 million acres previously authorized for enrollment in the program. Currently, about 31 million acres are enrolled in the CRP. USDA has announced its intent to maintain the CRP at its 32-million-acre statutory cap, but enrollments may decline to less than that target quantity based upon strong market demand for grains and oilseeds. The following graph shows the number of acres leaving the program over the next decade.



Overall, from a supply perspective, U.S. corn and soybean production has grown from approximately 10.7 billion bushels in 1985 to 16+ billion bushels in 2009. This growth is driven by market signals encouraging greater production reflective of demand for food, feed, renewable fuels and exports. Changes in production patterns, seed technology, and mechanization of production will continue to facilitate demand patterns that encourage increasing production of corn and soybeans. While production of corn and soybeans continues to grow, other smaller crops like oats and barley decline. The type of commodity and the number of acres are heavily impacted by the demand for commodities which will now be explored.

### **Demand Factors**

Many factors of the demand for grain have driven supply increases over the past several decades. Population growth and improved disposable incomes, particularly in developing countries, continues to be the primary drivers for increased overall demand. Improving diets have led to per capita consumption increases in protein, from meat and poultry, also impacting total grain and oilseed demand. Increased reliance on renewable fuels is a more recent trend which has affected domestic corn supplies with roughly one-third of U.S. corn production now directed to renewable energy. The growth of supply and increasing demand has created the need for efficiency improvements over time, which has led to grain elevator consolidation and encouraged productivity improvement in transportation.

### **Global Population and Consumption Trends**

A continuously evolving element of grain demand is the global development for an increasing global population. The second half of the twentieth century experienced extraordinary growth. Global population increased from 2.47 billion in 1950 to 6.70 billion today, with a forecast of 10.93 billion by 2050. The United States has also encountered substantial growth in the past few decades, attributed in large part to immigration. According to the 2010 census count, the population has reached 309

million, which is a 82 million increase since 1980. By 2020 the U.S. population is projected to grow another 7-15 percent, which would equate to an additional 20-45 million people to feed domestically.

In addition to growth, the world population has experienced an improved standard of living in recent decades, particularly in Asia which houses more than half the world's population. Growth in per capita income has influenced a diet that includes more protein. The Food and Agriculture Organization (FAO) of the United Nations data show that livestock production is growing rapidly, which is interpreted to be the result of the increasing demand for animal protein products. Since 1960, global meat production has more than tripled, milk production has nearly doubled and egg production has increased by nearly four times. This is attributed partly to the rise in population, as well as to the increase in affluence in many countries. <sup>(5)</sup>

A joint study done with the FAO suggested that global production and consumption of meat will continue to grow, from 233 million metric tons in the year 2000 to 300 million MT in 2020. <sup>(6)</sup>

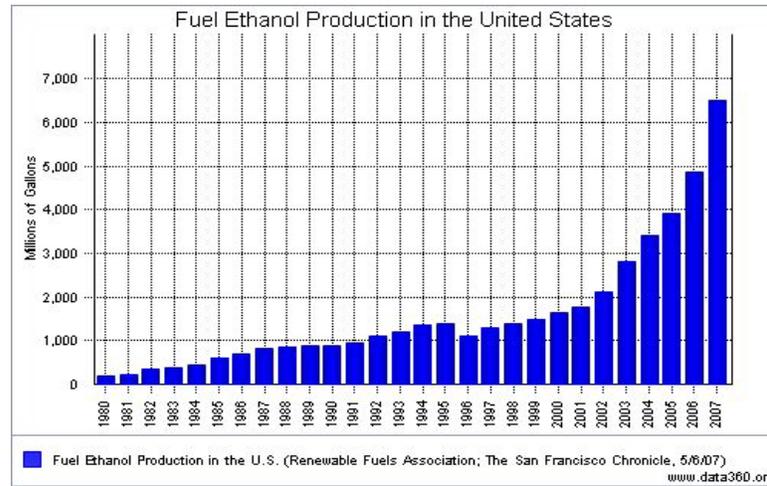
In response to global demand, domestic production continues to grow. Commercial livestock and poultry producers have increased demand for U.S. grains with massive commercial feeding operations in the South, Midwest and West. From 1950 to 2007 the demand for meat has increased over 54% on a per capita basis. In addition to per capita consumption, population growth over time has made for large scale production of meat to become increasingly important. These high technology feeders also require a consistent feed source and rely heavily on feed grains, and grain co-products shipped to them in unit trains from outside their immediate area.

<u>Year</u>	<u>U.S. Meat Demand</u>						<u>Total</u>
	<u>Chicken</u>	<u>Turkey</u>	<u>Veal</u>	<u>Lamb</u>	<u>Beef</u>	<u>Pork</u>	
	(retail cut equiv./ lb. per person)						
<b>1950</b>	21	3	7	4	44	65	144
<b>1955</b>	21	4	9	4	56	62	156
<b>1960</b>	28	5	5	4	59	59	161
<b>1965</b>	33	6	4	3	70	52	169
<b>1970</b>	40	6	2	3	82	55	189
<b>1975</b>	39	7	3	2	85	43	178
<b>1980</b>	47	8	2	1	75	57	190
<b>1985</b>	52	9	2	1	77	51	194
<b>1990</b>	61	14	1	1	66	49	193
<b>1995</b>	69	14	1	1	65	51	202
<b>2000</b>	77	14	1	1	67	51	211
<b>2001</b>	77	14	1	1	65	50	208
<b>2002</b>	81	14	1	1	67	51	215
<b>2003</b>	82	14	1	1	64	52	213
<b>2004</b>	85	13	0	1	65	51	216
<b>2005</b>	86	17	1	1	65	50	219
<b>2006</b>	87	17	1	1	65	49	220
<b>2007</b>	87	17	1	1	66	51	222

Source: USDA, Economic Research Service

## Renewable Fuels

Expansion of corn-based ethanol production has dramatically changed the consumption of corn in the United States. Production of ethanol in 2010 is expected to be approximately 12 billion gallons and is currently utilizing slightly over 4 billion bushels of corn. Within the next five years, or possibly sooner, the consumption of corn-based ethanol is projected to reach 15 billion gallons as mandated under the Energy Security Act of 2007. If this level of production is reached, ethanol will utilize 5.2 billion bushels of corn.<sup>(7)</sup> This increased demand for corn will continue to impact price and availability.



Supply and demand factors for grain and oilseeds influence the amount of product the United States plants on an annual basis. During any given year the supply and demand factors associated with grain and oilseeds impact production; however, the historical trend is that increasing supplies of grain are needed to feed a growing population. It is reasonable to expect this trend to continue.

## Elevator Consolidation

With the growth in meat consumption and global grain demand, the country elevator system has also continued to evolve into fewer but larger facilities able to load more grain in a shorter amount of time. Almost since the first grain elevator was invented in 1842 in Buffalo, NY the grain elevator industry has been changing.<sup>(8)</sup> Up until the early twentieth century small local elevators were the focal point of towns. Their locations coincided with the railroad building boom in the latter half of the nineteenth century, which helped create elevators within towns that gave the farmer the ability to deliver his harvest by horse and wagon and return home the same day.<sup>(9)</sup>

Since the Great Depression of the 1930's, the small family farm has continued to vanish and be replaced by larger technologically advanced operations – still owned and operated primarily by family or tenant farmers - that are more productive and profitable given greater economies of scale. For a while with the addition of annexes and steel bins, the

wooden country elevator was able to adapt; however, as farms grew larger and more mechanized, smaller operations simply could not compete. Ultimately this led the rural population to begin shifting to the city, resulting in the closure of many small-town elevator businesses. With railroads facing fewer potential passengers and freight in these smaller communities, the rail companies began to re-evaluate certain lines, often finding it necessary to abandon them and subsequently remove the tracks. Without rail service additional elevators were forced to close, or smaller non rail served operations survived by trucking their grain to larger terminal facilities.<sup>(10)</sup>

This consolidation further accelerated over the past two decades as country elevators consolidated with the capacity to load larger trains ranging from 65 cars in the Eastern U.S to as many as 110 cars in the Western U.S. These larger operations are able to gain maximum efficiency with single point loading and less car handling. Several operations also use short line railroad partners to co-load larger units within shuttle train time parameters, thereby preserving the short line railroad network and country elevator infrastructure. These changes have made the ability of moving grain more effective through equipment availability, the improved velocity of these train sets both empty and loaded, and more competitive transportation economics compared to other modes of transportation. This evolution has become particularly important as crop yields have improved and created more grain production in the U.S. and the need for U.S. grain to be competitive in a growing global marketplace.

Another recent factor contributing to the consolidation of U.S. grain elevators was the need to find capital to run operations. Grain elevators are typically capital intensive operations. Many country elevators experienced financial stress in 2008 during the rapid run-up in grain prices, that resulted in increased working capital requirements. Much of that stress was related to hedging positions taken in the futures market to mitigate price risk. In fact, hedging, the very tool used to reduce price risk, has in some circumstances become a risk itself due to soaring capital requirements created by large and frequent price swings in the futures market and resulting margin calls.<sup>(11)</sup>

The higher capital requirements necessitates a deep understanding of pricing sales with appropriate margins, and making sure that operating overhead is balanced and appropriate. In some cases, preserving working capital may require some tough decisions, such as putting off planned plant expansions, selling assets that are not critical to the business, holding off on new property and equipment purchases, or reducing dividend distributions (in the case of farmer-owned cooperatives) to owners to strengthen liquidity. Another option elevators are constantly exploring is partnering with other grain elevators. Working with a partner in a joint venture may be a practical and efficient way to spread risks and costs over multiple balance sheets. These kinds of arrangements may allow smaller operations to realize the benefits of the economies of scale that larger organizations enjoy.<sup>(12)</sup>

Industry consolidation has been occurring for the past several years as economies of scale related to grain handling, transportation, and destination receiver mills have continued to push for efficiencies. More innovative approaches are also being pursued such as partnering with short line railroads, shippers and receivers to meet shuttle train

parameters without overwhelming asset investment. It is reasonable to assume that this trend will continue albeit at perhaps a slower pace.

## **Section 2: Evolution of Railroad Grain Transportation**

As the grain industry continues to grow due to increasing yields and global and domestic demand increases, transportation has continued to evolve as well. The development of unit trains for agricultural products was driven by the customer's need to move more grain at a competitive price in a global market, as well as providing faster and more consistent transportation. The unit train concept also fit very well with the railroad's investment in locomotives with stronger pulling capacity and offers the railroad the opportunity to plan resources based on the consistent loading and unloading of trains within 15 hours. This section will specifically focus on railroad locomotive technology, the impact of faster and more consistent loading and the subsequent impact on car fleets.

### **Locomotive Technology and Development**

With the development of unit train shuttles in the 1980's the railroads also saw an improvement in locomotive technology with the development of Alternate Current (AC) locomotives. The conversion from Direct Current (DC) locomotives to AC locomotives created more tractive effort which allows railroads to increase train size without increasing the number of locomotives required to pull larger trains. The difference between AC and DC locomotives is that AC locomotives allow more tractive effort at slower speeds and are thus able to move greater tonnage from a stopped position. Today, as an example, some 100 or 110 car grain trains may require 4 DC locomotives but with the improved tractive effort may only require 3 AC locomotives.

During the 1990's locomotive productivity was further improved with the development of Distributive Power Units (DPU). A DPU is a locomotive that is equipped with remote control technology that allows the locomotive to be placed at the rear end of the train and is controlled from the lead locomotive. This creates a push / pull concept that reduces in-train forces which leads to better train handling, reduced car maintenance, mitigates risk of derailment, and allows the train to ascend and descend grades at a faster more consistent rate of speed to improve overall train velocity. Railroads have the ability to handle more cars over terrain with steeper grades by utilizing DPU technology.

Advancement in locomotive technology has enabled the railroads to become more efficient and allowed customers to ship more grain per train from a single origin to a single destination. Railroads have historically offered incentives for longer trains in part due to the productivity increases offered by these locomotives

## **Impact of Faster Loading /Unloading**

With the development of unit shuttle trains and requiring customers to load and unload trains within 15-24 hours, the railroads also improved performance with respect to pulling loaded and empty trains upon release or billing by customers. Over time, customers have become very consistent in meeting the 15-24 hour load/unload requirement, which allows railroads to call crews based on confidence that trains will be ready to depart 15-24 hours after actual train placement. Some railroads also require a 3 to 4 hour advance notice that the train will be completely loaded or unloaded to ensure that crews are not called in error.

In addition to providing for efficient utilization of crews, faster loading and unloading, allows locomotive power to stay with the train. Locomotive productivity is a key factor in reducing overall costs for railroads, and with the advent of unit train shuttles and the 15-24 hour load/unload requirement, railroads may leave power with the unit train shuttle to ensure crews can pull the loaded or empty train upon release or billing.

Faster loading/unloading of unit train shuttles assists railroads in improving their release to depart times, which adds consistency and velocity to the unit train move. Prior to the process above, railroads would allow trains to sit in excess of 24 hours, or more, before pulling empty or loaded trains, thereby increasing the total transit time and increasing variation of service. Railroads can now pull trains within hours of release from grain terminals which improves cycle times and predictability, and creates more efficiency for the customers and railroads.

## **Improvements to Fleet Capacity**

Fleet capacity can be enhanced by purchasing larger cars, improving utilization of the cars, or simply buying/leasing more equipment. A combination of all three strategies has been used over time, but most recently the focus has been on adding larger cars to the fleet and improving the utilization of that equipment. During the late 1980's the industry began to transition from the 4,750 cubic foot capacity covered hopper car to the 5,150 cu. ft. capacity car. This increased the maximum carrying capacity from 263,000 lbs. to 286,000 lbs. The process of converting to larger cars still continues today. From 1999 through 2008 the size of the U.S. grain fleet has increased 4%, and the carrying capacity has increased 8.5% mostly due to the evolution of car size from 4750 cubic ft car to 5100+ cubic foot car. <sup>(13)</sup>

The improvement in utilization as it relates to the evolution of unit trains can not be minimized as over that same period (1999-2008), Class 1 carriers have originated 17.9% more grain loadings on a fleet capacity which has only increased 8.5%. <sup>(14)</sup> This differential can almost exclusively be attributed to improved asset utilization associated with unit train shuttle movements.

Overall, the development of the unit train shuttle concept has improved overall train speed, improved asset utilization, helped to smooth out peak demand periods, and lessened the need for capital investment in equipment. With the consistent supply of

shuttles and less transit variability, grain customers have made significant financial investments to increase the efficiency of their assets and ship more volume. Railroads have better utilization and more capacity to move grain to market. Incentives paid by the railroad to participate in these unit train shuttle offerings have made them very attractive to both the originator and receiver of grain. Today it is estimated that over 65% of domestic and export grain moved by rail is shipped via a unit train shuttle program. This is a trend which will likely continue to grow into the future.

### **Role of Short Line Railroads in Grain Transportation**

Short line railroads have played an important role historically in the transportation of grain from rural growers to inland terminal elevators, international trade ports, and domestic end users. Some short lines serving agricultural regions were created after the Staggers Act allowed large railroads to transfer their light-density lines to entrepreneurial operators rather than attempt to abandon them. Others have served outlying regions from the early days of rail transportation. Collectively, the short lines have become an extensive capillary network affording continued rail service to country grain elevators and other agribusinesses, and general industry in areas where large railroads cannot operate efficiently.

As this report notes, the large-railroad service model envisions collecting grain shipments at consolidation points along the main arteries, fed by truck or connecting branch/short-line rail lines. Light-density railroads serving many rural grain shippers do not provide the volume of business needed to justify capital investment by the large carriers. Small railroads can, however, offer their customers the benefit of the individually tailored, seasonal service that is the hallmark of short-line operations. Because they typically do not have access to the major capital markets, these short line and regional carriers have attracted support from the public sector to build and preserve their rail infrastructure. In some cases state Departments of Transportation have purchased light density lines and contracted with small railroad companies to operate them. States have also provided outright grants to preserve and upgrade rail lines in rural areas. At the federal level Congress has recognized the importance of small railroad service by enacting a 50% tax credit to encourage and help underwrite small railroad infrastructure investment. Since its enactment in 2004 the federal tax credit has infused hundreds of millions of dollars into upgrades and improvements on small railroad light density lines, many of which serve outlying grain shippers.

Without their short-line railroad connections, growers would lose the ability to ship grain by rail to the modern shuttle-loader collection points along the large railroad main lines, leaving them with only one option to reach the shuttles: the truck. Trucking is too expensive in many locations to be a viable long-term transportation solution, is more cumbersome to deal with than the railroad, and cannot reliably provide sufficient capacity at times of peak demand.

Grain shipments on short lines from remote and economically sensitive rural areas assure the availability of rail service for other agribusinesses and manufacturers as well. Non-grain shippers in these agricultural hinterlands typically cannot support the operation of the short line railroads on their own. If the rail business generated by grain shippers were to disappear, the network of rural short lines would atrophy, causing economic prospects for the whole region to decline. Thus, grain shippers and short-line railroads

play a symbiotic role in the economic stability and diversification of geographically isolated rural areas.

In addition to regional economic support, short-line service to grain shippers also reduces the public cost of upgrading and maintaining secondary highways and rural roads if trucking became growers' only transportation option. Further, lower emission rail transportation has less effect on air quality than truck transportation, helping public policy makers reach attainment goals and improve energy efficiency. Short lines therefore play a key role in both the continued vitality of geographically disadvantaged grain producers and the economic health and welfare of the rural regions they serve.

### **Section 3: Impact of Technology on Railroad Performance**

Agricultural shippers and consumers have been concerned about the capacity of the railroads to serve their needs for several years. Even with improvements in asset utilization from programs like unit train shuttles and quick loading/unloading incentives, demand is forecasted to increase in the railroad industry due to growing markets, such as energy and Intermodal transportation. The US Department of Transportation recently reported that freight railroad demand is expected to increase by 88% by 2035, and concluded that \$148 billion must be invested in railroad infrastructure expansion to keep up with the anticipated demand.

The railroad is a capital-intensive industry, investing almost 18% of their revenue on capital expenditures (compared to 3% for the average manufacturer), and spending nearly 80% of their capital expenditure budget just maintaining track miles already in place. A shortfall of investment could create widespread service failures, which would be devastating to the industry and their customers.

Class I railroads are actively investing in physical infrastructure, such as laying new track, building new terminals, and expanding fleet capacity; but with the significance of projected growth in demand, physical infrastructure will only satisfy in the interim. This reality has further shifted interest and investment in enhancing their system technologies to increase capacity virtually in addition to physically.

Rail capacity is vital to maintaining fluidity, efficiency, and customer satisfaction. Rail capacity increases as train speed (velocity) increases and terminal dwell decreases. By investing in technologies that focus on improving overall velocity, data retrieval, and dwell, railroads will be in a better position to meet increased demand and remain a cost effective option for their customers.

A few examples of technologies that the rail industry are currently reviewing, upgrading, or implementing are the following:

- *AEI (Automatic Equipment Identification)* is an electronic recognition system used to identify railroad equipment while en route. This data is not only used for operational efficiency but can be viewed online or sent to the shipper's own system for real time tracking.

- *Defect Detector* identifies when railroad tracks or rail cars require maintenance. Enhancements in this system have allowed for services to be done prior to severe damage occurring, minimizing the possibility of derailments.
- *Fuel Optimization System* helps locomotive engineers operate trains more efficiently. This software is integrated into the in-cab electronic communication system and will calculate optimum speed at which to operate the train, depending on topography, curvature of the track, train's length and weight, etc.
- *Greener Locomotives* promote fuel efficiency and reliability. The rail industry has been investing heavily in new diesel engines to replace retiring locomotives and to handle increased demand. General Electric continues to improve their product, with plans to roll out a hybrid locomotive (ES44C4-Evolution Series) in 2010. Following suit with their railroad customers, General Electric is heavily investing money into better train technologies. The switch to hybrid locomotives would lead to fuel savings of about 70 million gallons annually, equivalent to taking about 115,000 cars off the road.
- *Positive Train Control (PTC)* is a system of monitoring and controlling train movements to provide increased safety. PTC allows the train to receive information about its location and where it is allowed to safely travel. Having the equipment on board prevents unsafe movement. Creating a safer railroad reduces liabilities and minimizes accidents that can slow down velocity.
- *Travel Plan Optimization System (i.e. RailEdge Movement Planner / Software Algorithms)* is software that processes train schedules, traffic control systems, and train movements relative to each other across the network to create an optimized traffic plan. Some models predict locomotive and crew requirements for train schedules. An optimized travel plan increases on-time deliveries, since trains will be routed to avoid delays. This creates tangible performance benefits as it increases the average network velocity speed by 10-20%, or 2 to 4 mph. One mph in velocity improvement can save approximately \$200 million in capital expense annually.

In order to move agricultural products to market in the most efficient and cost-effective manner, adequate rail capacity is required. Changes in supply and demand of grain both domestically and globally will continue to influence larger elevators, terminals and feed mills. As such, railroads will need to continue to develop programs like unit train shuttles and fast load/unload programs which leave locomotives available and ready to move agricultural products. Investment will also be needed in technology, maintenance, and infrastructure expansion of the rail and grain industry. Most importantly, communication and strong business relationships will continue to be an important component within the Agriculture Industry.

## REFERENCES

1. United States Department of Agricultural Crop Production Reports, (Washington, D.C. 1985 and 2008).
2. Brookes, G. & Barfoot, P, “Global impact of biotech crops: Socio-economic and environmental effects in the first ten years of commercial use.” AgBioForum, Vol. 9, No 3, 139-151 (2006)
3. Ibid., p. 1.
4. United States Department of Agriculture, “The 20<sup>th</sup> Century Transformation of U.S. Agriculture and Farm Policy”, March 2006.
5. Andrew Speedy, “Global Production and Consumption of Animal Sources,” The Journal of Nutrition, (November 2003).
6. Ibid., p. 1.
7. The ProExporter Network, 2009
8. William J. Brown, The Grain Elevator 1843-1943 (Colossus Books, 2009).
9. Barbara Selym, “The Legacy of Country Grain Elevators,” 2000 p. 42.
10. Ibid., p. 45.
11. Phil DiPofi, “Grain Industry must Evolve, Adjust to a New Market Paradigm,” Rural Cooperatives, Vol. 75, No. 6 (November/December 2008).
12. Ibid., p. 1.
13. Association of American Railroads, The Rail Transportation of Grain, , July 2009, 63.
14. Ibid., p.63.