

PLASTICS MARKET WATCH

A SERIES ON ECONOMIC-DEMOGRAPHIC-CONSUMER &
TECHNOLOGY TRENDS IN SPECIFIC PLASTICS END MARKETS
SPRING 2015 | ISSUE I

WATCHING:

Automotive & Transportation

Plastics

IN THE FAST LANE

More information:
www.plasticsmarketwatch.org



Copyright and Disclaimer

© 2015 SPI: The Plastics Industry Trade Association. All rights reserved.

This report has been prepared by SPI as a service to the industry. The information is offered in good faith and is believed to be reliable, accurate, and complete, but is provided without any warranties, express or implied, including (without limitation) warranties of merchantability and fitness for a particular purpose. SPI does not assume, and hereby disclaims, any liability arising out of or relating to the use of or reliance upon any information contained in this report.

A SERIES ON ECONOMIC-DEMOGRAPHIC-CONSUMER &
TECHNOLOGY TRENDS IN SPECIFIC PLASTICS END MARKETS

Contents

Foreword..... 1
Current Economic State.....4
Economic Trends 7
Demographic Trends 14
Policy Trends.....18
Technology Trends22
Labor Trends31
Culture Trends.....36
Conclusions 40

Special thanks to the SPI Plastics Market Watch work group for their guidance and input on this Automotive & Transportation Report.

- Conrad Bessemer, Novatec, Inc.
- Fred Daniell, Kureha America Inc.
- Larry Doyle, Conair
- James Clark, Printpack Inc.
- Jay Cude, ITW Medical
- Tad McGwire, Industrial Heater Corp.
- Jeff Mengel, Plante & Moran
- Jim Murphy, Davis-Standard, LLC
- Dave Preusse, Wittman Battenfeld, Inc.
- Phil Wilson, BASF

Materials compiled, written and edited by Hansel (Hank) Cox, with editorial assistance from Michael Taylor and Kendra Martin, SPI.

Foreword

As we look for ways to better serve our SPI membership and the broader plastics industry supply chain, one area of continued discussion is the impact of the consumer on our businesses. Factors such as demographics, cultural trends, new technologies, and public policy direction impact the way we make our products and how they are consumed.

With this as a backdrop, SPI is undertaking a unique report series that will explore key factors—including demographics, economics, public policy and technology—that

impact the plastic industry's key end markets. This report is about the plastics revolution in transportation—primarily, but not limited to—cars and trucks. It will be followed by reports on Plastics in Medical Device Applications, Plastics in Packaging, and Plastics in Housing & Construction.

Our goal is to come up with forward-looking reports for our members and the industry that blend economic data and demographic data to paint a true picture of where we are headed in these critical markets. Where it is relevant, we will weave in other factors such as public policy, technology trends, and resource issues. These reports can then be used to

present information on key drivers back to company personnel as input for their own strategic planning activities.

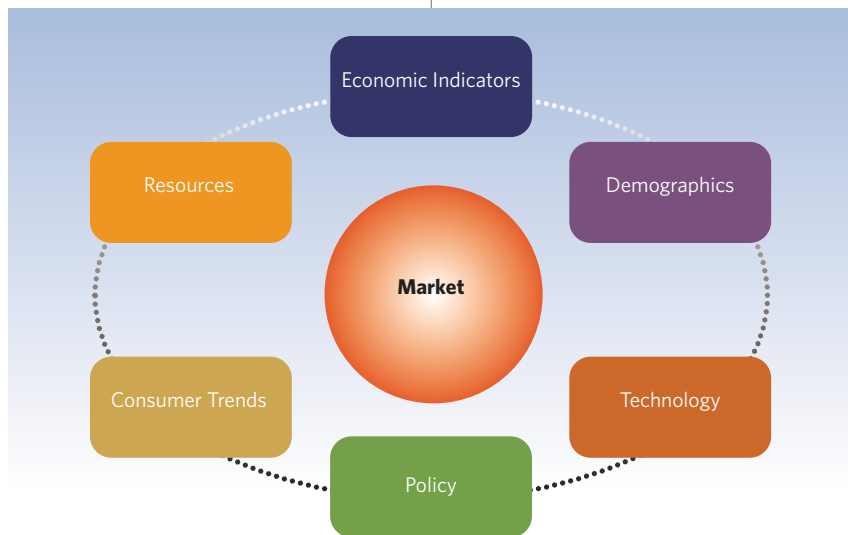
We plan to conduct presentations and webinars in conjunction with each report to discuss our findings, and hope that these will provide important food for thought, whether you are an equipment manufacturer, materials supplier, processor, recycler or brand owner. As always, we welcome your feedback.

Kendra L. Martin

Senior Director, Industry Affairs (Brand Owners)

SPI: The Plastics Industry Trade Association

Key Drivers for End Markets





Automotive &
Transportation

Current
Economic State

Current Economic State

Current Performance

The recently published 2015 North American Plastics Industry Study conducted by Plante Moran indicated that the median company had year over year earnings growth exceeding 14 percent for the past two years, and the top quartile exceeded 42 percent earnings growth. Below is a sample of key performance characteristics of plastics processors that have at least 25 percent of their sales to the transportation industry.

The transportation industry is supported by a few large plastics processors while the rest are predominantly small- to mid-sized.

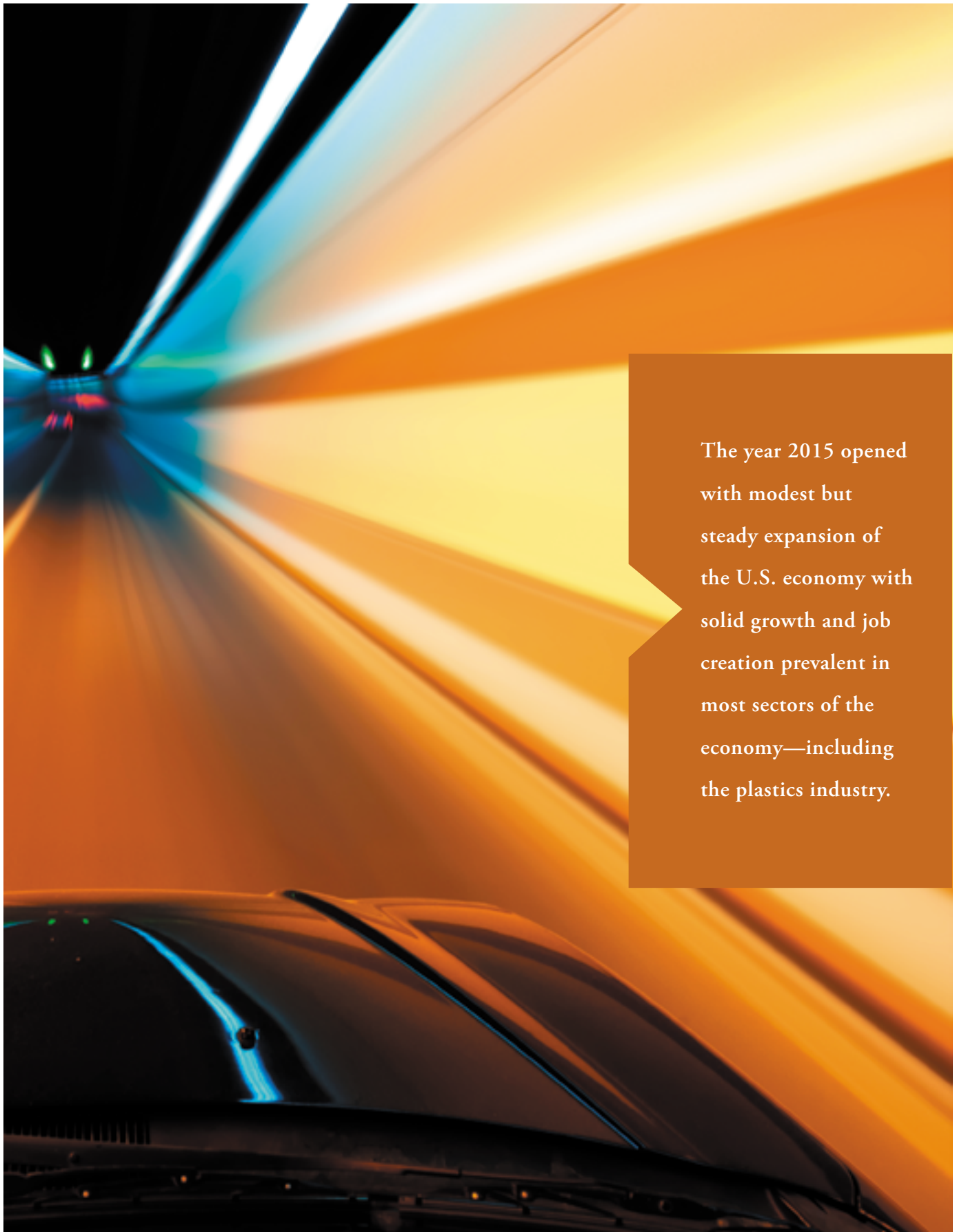
The remainder of this report will address the emerging trends—including demographics, economics, policy and technology—that impact the transportation industry. The statistics below indicate where we are now, but knowing where we are going will help you develop strategies and tactics to take advantage of the emerging trends.

Transportation	Range of Data by Quartile		
2012/Data	Lower 25%	Median	Upper 25%
Size			
Total Sales	\$ 14,829,359	\$ 24,176,000	\$ 45,316,622
Total Assets	\$ 7,177,777	\$ 11,121,847	\$ 21,000,000
Total FTE	99	138	260
Productivity Performance			
Value Add per Employee	\$ 69,981	\$ 82,082	\$ 92,862
Value Add per Loaded Labor \$	\$ 1.70	\$ 1.84	\$ 2.06
Operational Metrics			
Press Utilization (based on 24/7)—Injection Molding	34.3%	41.9%	55.4%
Customer PPM	4	116	660
Internal PPM	9,901	18,603	25,759
Delivery %	97.4%	99.0%	99.8%
Inventory Turns	6.7	8.9	11.1
Earnings Performance			
Earnings before Interest, Taxes, Depreciation, Amortization	6.9%	9.5%	12.8%
Return on Assets	4.3%	8.5%	14.9%
Growth Trends			
Two Year Sales Growth	4.1%	10.1%	20.5%
Two Year EBIT Growth	(14.2%)	14.1%	42.7%
Balance Sheet Health			
Current Ratio	1.2	1.6	2.7
Debt to Equity	0.5	1.4	3.2

Automotive &
Transportation

An orange arrow pointing to the right, containing the text "Economic Trends".

Economic
Trends



The year 2015 opened with modest but steady expansion of the U.S. economy with solid growth and job creation prevalent in most sectors of the economy—including the plastics industry.

Economic Trends

Plastics and Automobiles

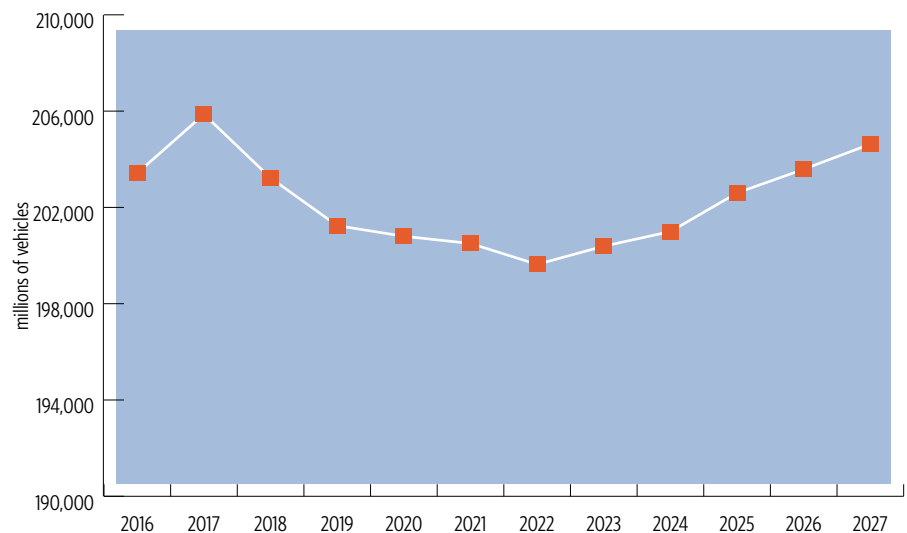
The year 2015 opened with modest but steady expansion of the U.S. economy with solid growth and job creation prevalent in most sectors of the economy—including the plastics industry. The strong economy is reflected in sales of automobiles and light trucks, which rose from a low of 10.4 million units in 2009, and are expected to hit 16.8 million in 2015. This is less than the record 17.1 million sold in 2001, but still a solid number that bodes well for the overall economy—and also the plastics industry, which is heavily involved in motor vehicles of all types.

The global manufacture of cars and trucks in 2014 was just over 87 million, expected to rise to 91.2 million in 2015. Eventually, according to its state-run People's Daily, China aims to produce more than 100 million vehicles each year.

The dynamics of the automobile industry are such that declines of the magnitude that occurred in 2009 inevitably lead to major disruptions among suppliers. The rapid recovery of the automobile industry has been a key driver of the overall recovery of U.S. manufacturing which lost 5.7 million jobs in the first decade of the new century. Much of the bounce-back can be attributed to pent-up demand from the down years when many consumers for financial reasons and uncertainty about the future of the economy delayed purchasing new cars and trucks.

There are at present an estimated 250 million vehicles on the road in the

U.S., of which the average vehicle is 11.4 years old, projected to rise to 11.7 by 2019, suggesting they will soon need to be replaced. In the U.S., Canada and Mexico, light vehicle sales are expected to hit 20.3 million in 2016 rising to 20.6 million by 2017. After 2017, however, light vehicle sales are expected to decline through 2022. After 2022, sales are predicted to rebound reaching 20.5 million in 2027.¹



Another interesting aspect of the U.S. automobile industry picture is foreign sales, which in 2014 hit a record for the third year in a row—about 2.1 million. It was the first time automobile and truck exports topped 2 million. About half of these exports predictably went to Canada and Mexico.

A big part of the increase stems from American-built Fords, Jeeps, BMWs and even Nissans and Toyotas shipped overseas. “The U.S. has become one of the low-cost places to build cars,” said Ron Harbour, a senior partner with the Oliver Wyman, Inc., consulting firm.²

There are solid reasons the economy is doing so well. The first and most obvious is the rebound from recession that took a lot longer than anyone

The strong economy is reflected in sales of automobiles and light trucks, which rose from a low of 10.4 million units in 2009, and are expected to hit 16.8 million in 2015.

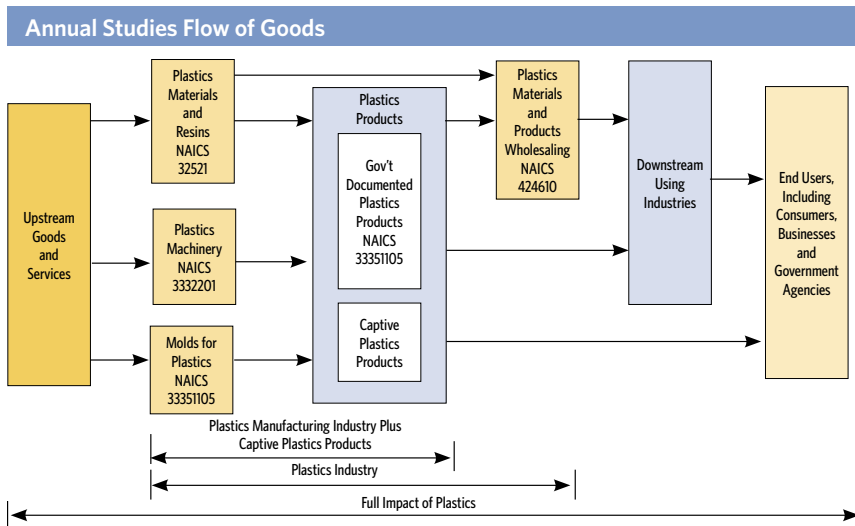
¹ IHS Automotive.

² U.S. Auto Exports Top 2 Million in 2014, *The Wall Street Journal*, February 6, 2015.

expected, but is at last conspicuously in evidence. Over the last several years, millions of consumers have been unemployed or under employed, and millions more have been fearful of losing their jobs. But as the economy has gradually gained strength, the fears have subsided. More people are returning to work and consumers are opening their wallets with added economic confidence. Consumer optimism as always is a key indicator of growth to come.

Overall Contribution of Plastics to the Economy

Because of its wide dispersal throughout the economy, U.S. government statistics alone do not provide a comprehensive data-based picture of the significance of plastics. The overall structure of the plastics industry is represented by Figure 1, which shows the flow of goods and services, such as chemicals and transportation, flowing into the plastics materials and resins industry, as well as into industries producing plastics working machinery and molds for plastics.³ The resins, machines and molds are then provided to the manufacturers or processors who convert the resins into bottles, film,



pipe and other plastic products.

Captive plastic products represent the other major classification of plastics products. These are produced in plastic processing activities similar to those measured by the U.S. government but are not located in establishments that the government specifically identifies as being plastics-related. Captive plastic products include items like plastic milk jugs that are blow-molded in dairies and automobile bumpers that are injection molded in automotive parts manufacturing plants.

A small portion of all plastics materials and resins go to plastics wholesale trade firms that sell them to either downstream users or to upstream plastics facilities. Most plastic products, however, are provided directly to downstream-using industries such as automobile manufacturers and home appliance plants, where additional assembly or processing steps are performed. Other products such as children's toys, plastic tote-bins or eye shields for military use go directly to end users without further processing.

Based on total dollars in annual shipments, the plastics industry is the third largest manufacturing sector behind the petroleum and automotive industries respectively, and the long term growth rate of plastics compares favorably with manufacturing as a whole (below). In 2012, the plastics industry, including plastics materials and resins, govern-

ment-documented plastics products, plastics working machinery, molds for plastics, plastics wholesale trade and captive plastics products generated \$372.8 billion in shipments and employed 891,600 people with a total payroll of \$41.7 billion.⁴

Growth Rates: 1980-2012		
	Plastics Mfg	All Mfg
Employment	0.1%	-1.4%
Real Shipments	2.3%	0.3%
Real Value Added	2.2%	0.7%
Productivity Growth	2.2%	1.7%

Economic Impacts of Shale Gas

Growing demand has been augmented by unforeseen factors such as the sudden explosion of the shale gas industry that has revolutionized the natural gas market, bringing online vast new supplies that have led to lower prices. According to William R. Carteau, President and CEO of SPI: The Plastics Industry Trade Association, "The shale revolution has made U.S. plastics much more competitive. About 85 percent of U.S. made plastics are made with natural gas, which fell in price 32 percent in 2014."

Suddenly, the new port facilities that were built around the country initially to receive liquefied natural gas (LNG) from foreign countries are today being retrofitted to export natural gas, a process already underway.

One critical result of lower natural gas prices has been to put more disposable income into the hands of consumers who are paying less to heat their homes, but the most dramatic immediate impact is upon business, especially manufacturing, which has always been a major consumer of natural

⁴ Size and Impact of the Plastics Industry on the U.S. Economy, SPI November 2012, p.S-3.

³ The SPI Magazine, Spring 2014, p. 19.

gas. Several key industries—most notably plastics—use natural gas as both a source of energy and a feedstock. A strengthening economy and rising consumer demand combined with lower costs for natural gas is creating as positive an environment for the plastics industry as has ever been imagined. The industry was already on a strong growth trajectory and even greater results are expected in 2015.

The overall consumption of plastic goods in the U.S. grew 6.5 percent from \$251 billion in 2012 to a record-setting high of \$267.3 billion in 2013.

It is estimated that the increased shale gas development will result in 6.0 percent added industrial production for resin manufacturing in 2020 and in 8.1

percent in 2025. Plastic product manufacturing as well will see 4.1 percent added industrial production in 2020 and 4.6 percent in 2025.⁵

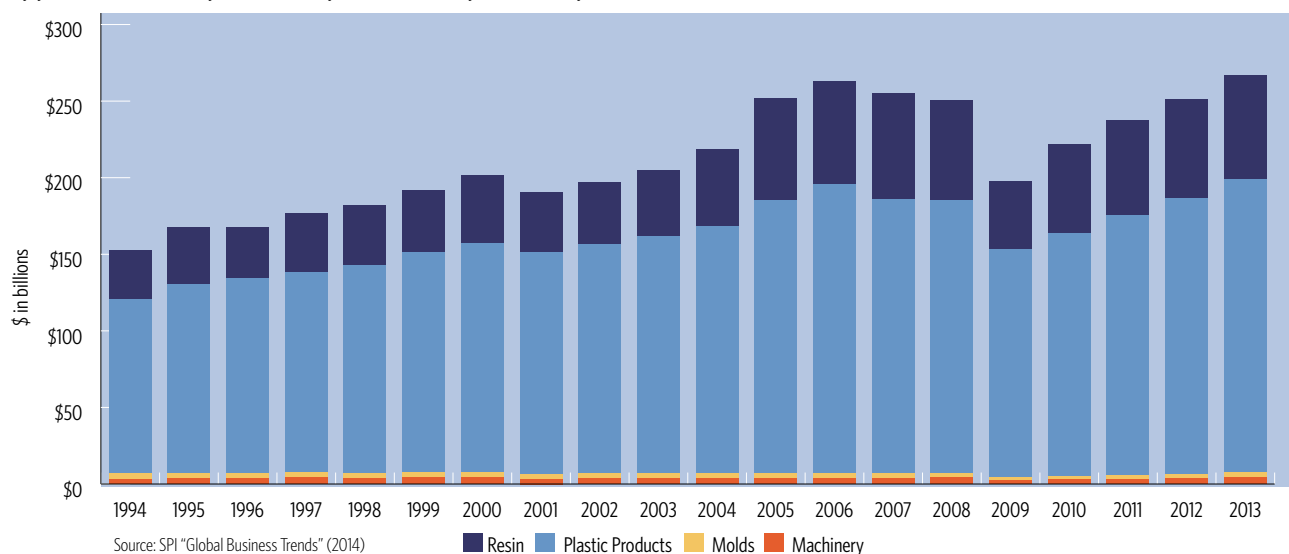
The dramatic changes in the natural gas market were followed by a sudden and largely unexpected collapse of oil prices that have dipped below \$50 a barrel. Cheaper oil is leading to cheaper prices for gasoline at the pump that in turn encourages more sales of cars and trucks—and all the plastic they contain. And historically, abrupt dips in the price of gasoline lead to increased sales of larger vehicles, which tend to use more plastic than smaller ones.

Declining prices for natural gas and oil also lessen upward pressure on inflation, which was weak in any event. With at most marginal inflation on the horizon, there will be less pressure on the Federal Reserve to raise interest rates. The Fed has already curtailed its controversial quantitative easing program that in effect pumped trillions of dollars into the economy, which suggests a sentiment at our central bank that the economic crisis is easing, if not already passed.

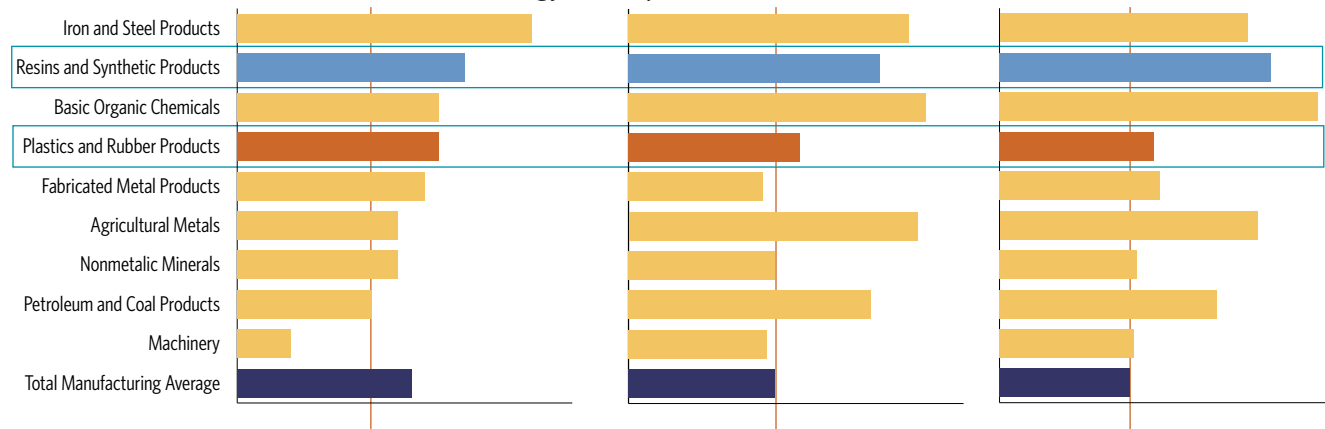
The dramatic decline of prices of natural gas and oil is good news for the plastics industry as a new wave of feedstock and resin capacity expansion is well underway, making it likely that resin capacity and exports will increase.

⁵ IHS 2014.

Apparent Consumption = Shipments + Imports - Exports



Added Industrial Production as a Result of Energy Development



Economic Impacts of Re-shoring

Another positive development is the reversal of the long-term trend of U.S. firms to export manufacturing to foreign countries taking advantage of lower wages overseas and also gaining more ready access to foreign markets. This has been going on for a long time. However, in recent years, we have seen growing evidence that the outsourcing wave has crested and that a growing number of manufacturers are bringing production back to the U.S. from China and elsewhere. This trend is conspicuous in the plastics industry, which is uniquely suited to take advantage of the decline of natural gas prices. But there are many other reasons for re-shoring:

- Wages of workers in China and other Asian countries are rising as a natural result of growing prosperity around the world generated by increasing trade and growth. This rise erodes the competitive advantage of our foreign trading partners.
- The Asian countries, most notably China, are seeing their production costs increase as the citizens demand greater investment in environmental protection to reduce air and water pollution, costs that are already built into the U.S. manufacturing environment.
- The long delivery time and costs associated with international transportation of finished goods are increasingly burdensome to commerce.
- Lack of respect for intellectual property in many foreign countries means that companies producing overseas often must accept abuse of their patent and copyright property.
- The shortening of lifespans for many products such as household appliances due to advancing technology and changing consumer preferences make it more cost effective for many firms to keep production closer to their home base.

The consulting firm of A. T. Kearney, Inc., released an analysis of the re-shoring trend in which U.S. manufacturers are returning work from overseas. It acknowledges that the landscape is changing in favor of U.S. based manufacturing: abundant energy at low cost, a productive workforce, cheap capital, interest in shorter supply chains and the growing popularity of the “Made in America” movement, as opposed to rising labor costs overseas, concerns about protection of intellectual property and costly transportation of finished goods over long distances. For example, recent backlogs during the dispute between shipping companies and dock workers on the West Coast delivered a clear message that such labor disruptions could have an adverse impact on ocean freight rates and international shipping times. Also, the shortening turnaround time for introduction of new products makes it more cost efficient for manufacturers to keep more production nearby.

On the downside, manufacturers seeking to return work to the U.S. face some serious hurdles. The exodus of so much manufacturing has contributed to a shortage of people with the requisite skills to work in modern manufacturing, and much of the infrastructure of suppliers who once provided critical parts to manufacturing has withered. Also, today the soaring U.S. dollar is making U.S. products less competitive in world markets. As a result, many of these products are being near-shored in Mexico.

This issue was discussed in detail at the Plastics News Executive Forum in Wesley Chapel, Florida, February 23–26, 2014. The re-shoring of much work in automobile manufacturing has exposed a tool shortage at a time when new cars require more molds and dies, and more complex ones, than ever before. “We really think there’s a pending tooling capacity constraint,” said Laurie Harbour of Harbour Results, Inc. By 2018, she said, the

North American automotive sector will need \$15.2 billion of tooling to accommodate new launches that hit a record of 46 in 2014. To make an average vehicle, automakers and parts suppliers use more than 3000 dies and plastic molding tools. The tooling for a complete front fascia assembly, not including lighting, can cost \$500,000 to \$1 million requiring more than 35 tools.

The current capacity to make tooling for the North American automobile industry is \$11.25 billion only about \$1 billion of which comes from China, Harbour said. That’s enough to meet current demand. However, by 2018 it will have to grow by at least 64 percent. Harbour Results found that automakers and suppliers plan to keep sourcing about 20 percent of the volume of their tools from China, but most of these are simple tools and the Chinese often miss shipment deadlines. In any case,

The dramatic decline of prices of natural gas and oil is good news for the plastics industry as a new wave of feedstock and resin capacity expansion is well underway, making it likely that resin capacity and exports will increase.

China will not be able to fill the growing capacity gap because labor rates continue to increase and a growing slice of their product will be taken by the growing Chinese automobile industry.

“Lead times are significant, which I think is driving more reshoring,” Harbour said. “The challenge here is there is still tremendous pressure on tooling costs.” U.S. tooling suppliers are working to boost capacity, but there is a \$6 billion gap. Most of the work is being done by larger firms with sales over \$30 million. Smaller shops are less competitive and have new opportunities to do non-automotive molds.

Conclusion

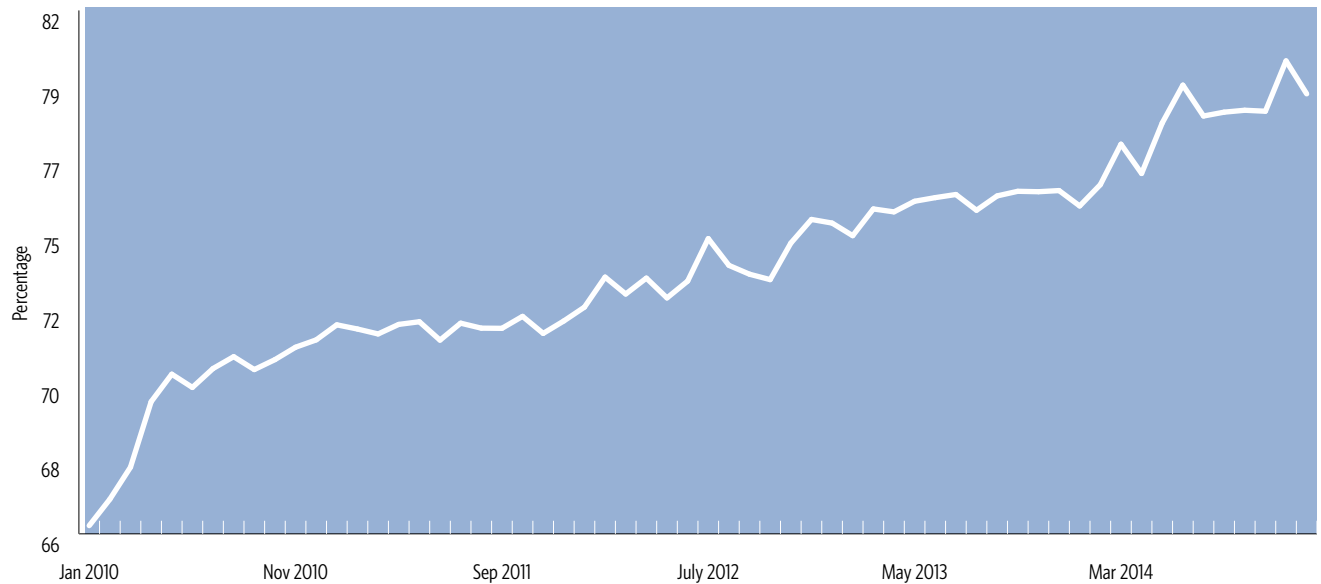
The overall picture of the U.S. manufacturing sector is positive compared

to our major trading partners. Manufacturing capacity utilization was 78.4 percent in December 2014, higher than December 2013 before and equal to its average over the past 40 years. Plastic product manufacturing capacity utilization was 79.4 in December, and has been above 70 since the second quarter of 2014.

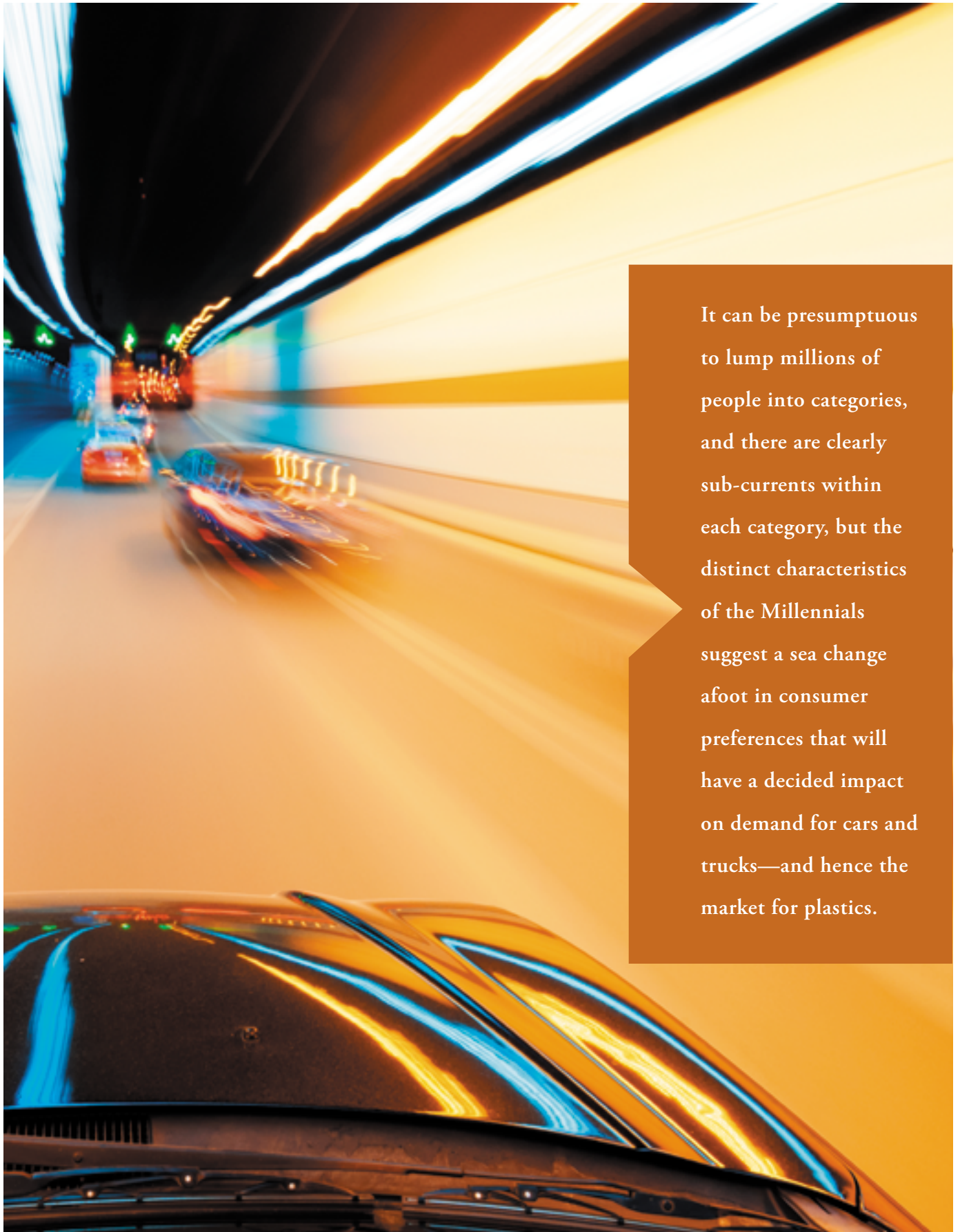
We will never bring back all of the manufacturing that has moved overseas, especially the low-end, labor intensive work. Our goal should be to dominate high end manufacturing that reflects emerging technologies that are frequently found in the more advanced plastic processors in the U.S.

The near term prospects for the plastic industry, as for most industries, are positive. The nation’s economy is growing and manufacturing—including the plastic industry—is leading the parade, but many parts of the world are in a perilous state, economically and politically. The need for skilled workers today is perhaps only exceeded by the need for more visionary leadership.

Plastics and Rubber Products (NAICS = 326): s.a. CAPUTL



Source: Federal Reserve Board 2015



It can be presumptuous to lump millions of people into categories, and there are clearly sub-currents within each category, but the distinct characteristics of the Millennials suggest a sea change afoot in consumer preferences that will have a decided impact on demand for cars and trucks—and hence the market for plastics.

Automotive &
Transportation

Demographic
Trends

Demographic Trends

The Millennial Generation

While a substantial and rapidly growing segment of the plastics industry today is a direct result of its phenomenal impact on the automobile industry, there are conspicuous trends in consumer behavior that suggest this historic norm may not continue to prevail indefinitely. The most obvious one—and one that has demographers scratching their heads—is the Millennial Generation of Americans, sometimes called Generation Y, which now comprises the largest single segment of the population. Unlike their parents, Gen Y has no great love affair with the automobile and when asked what they would give up first, their car or their phone, their answer is almost always unanimous: their car. What does this mean to automobile production, or to public transportation? Detroit and Japan are watching.

It can be presumptuous to lump millions of people into categories, and there are clearly sub-currents within each category, but the distinct characteristics of the Millennials suggest a sea change afoot in consumer preferences that will have a decided impact on demand for cars and trucks—and hence the market for plastics.

The Millennial Generation does not come with a specific definition though most researchers and commentators employ the birth years ranging from the early 1980s to the early 2000s. Depending upon which years you use, the Millennial Generation is about 100

million strong, by far the most distinctive grouping. Baby Boomers number only about 78.2 million and Generation X, the one that came right before Generation Y, totals about 69.5 million.

A variety of surveys of Gen Y—the Millennials—reflect a generation that differs significantly from its predecessors. They are more focused on wealth and less concerned about politics and philosophical questions. They generally have liberal attitudes toward social and cultural issues such as same sex marriage and legalization of marijuana, and



are more receptive to liberal economic policies. Sometimes called “Generation Me”, they tend to narcissism and also optimism; they believe the world will improve and they will have useful roles in it. They get their information from the Internet and seldom spend time with newspapers or magazines. They would rather text than call on the telephone, which can lead to inefficient communication not to mention car wrecks.⁶

This brings us to our primary concern with the Millennial Generation—their attitude toward traditional values. They have come of age during the toughest recession since the 1930s, and despite their innate optimism, they are skeptical of the American dream. Many of them are saddled with onerous debts from college—all told totaling more than a trillion dollars.

Presumably because of the psychological impact of The Great Recession and their cumulative debt, Millennials are more reluctant than previous generations to marry and start families. (A similar trend prevailed during The Great Depression of the 1930s.)

⁶ *Millennials Rising: The Next Generation*, William Strauss and Neil Howe, Vintage 2000.

In 1960, only 12 percent of adults aged 25–34 had never married. By 2010, 47 percent of that cohort had never married. Many of them are still living with their parents and those living on their own are much more likely to rent than buy a home or condominium. They are likewise reluctant to buy a car depending instead on mass transit or rental vehicles, which are increasingly available.⁷

In fact, a growing number of Millennials do not even have a driver's license. The rate of licensing peaked in 1983 and has been inching down ever since. Less than 80 percent of people aged 20–24 today have driver's licenses. Only a little over half of teenagers from 16–19 have licenses. Those who do spend less time driving and more time online in a variety of activities such as shopping, gaming, reading and social media like Tweeting and keeping up with friends on Instagram. They take fewer drives in the country or to visit relatives in distant cities than their parents do. "Detroit's car-buying sweet spot is a bell-shaped curve representing customers between 35 and 45 years," said Ken Gronbach, multi-generational marketing expert and author of *The Age Curve: How to Profit from the Coming Demographic Storm*. "The best customer for a new American car is a 43-year old male. This customer buys more new cars than anyone else."

Another factor in the equation is the increasing life-span of the average automobile. Vehicles made today are much higher quality than even a few years before, in part because of the extraordinary quality of plastic components, and thus can be expected to remain in use much longer. In sum, if automobile and light truck sales continue to grow past 2018, it will likely be at a slower rate than in the past.

⁷ *On The Road Again?*, Dr. Donald A. Norman, Director of Economic Studies, MAPI.

In addition, a key driver of economic growth has always been the construction of new houses and formation of new households that create demand for a host of consumer products—such as appliances, video technology, computers, lawnmowers and so forth. But a declining percentage of young Americans are getting married and setting up households today, and otherwise engaging in the traditional activities that have always sustained economic growth, even in difficult times, such as buying cars and trucks. Indeed, a growing number of Americans are rejecting the very concept of personal vehicle ownership.

There is a marked decrease in commuting as a growing number of people make it a point to live closer to their employment. Although vehicle miles travelled per capita has declined since 2005, total miles per vehicle has edged up since 2009 after declining in 2007–08. Even so, miles travelled per vehicle remains 10 percent below its 2005 peak. That said, declining vehicle ownership will likely provide stimulus to other transportation modes that use large amounts of plastic—such as airplanes, passenger trains and urban metro systems—but not enough to offset the loss in the automotive sector.

Despite these cross-currents, Gronbach contends the overall picture of the U.S. market is positive. "The U.S. represents only 5 percent of the world's population but generates 25 percent of the world's economy. It would follow that the U.S. transportation needs and plastic consumption will be vast until further notice." He adds, "The minority population is advancing socio-economically as never before," he said. "They will consume more and more transportation and plastic. Some 80 million Baby Boomers will be living longer and show no signs of reducing their inhaling of transportation."

Global Demographic Forces

If there is one Biblical commandment that people all over the world of all races, creeds and religions honor, it is surely the one in Genesis where God says to "be fruitful and multiply." In 1900, the total world population was about 1.6 billion. After more than a century of wars, famines, genocide and epidemics the roll call of humanity has topped 7 billion and is accelerating—expected to exceed 8 billion by 2030. The bulk of the population increase is occurring in less developed countries, but the definition of that phrase requires constant reinterpretation. Even in less developed countries, cars and trucks are rapidly becoming staples of daily life for hundreds of millions of people. Today as ever, access to a vehicle is both an economic advantage and a positive statement of one's position in society. That is unlikely to change within the foreseeable future.

Predictably, the lion's share of the increase in sales of cars and trucks is occurring in the more developed countries, a segment that is growing by leaps and bounds. Advanced and growing countries of increasing wealth where hundreds of millions of ordinary citizens can reasonably aspire to own vehicles for personal use dominate the Americas, Europe and Asia. Brazil, India, Russia, and a host of other up and coming countries boast vibrant vehicle markets. China, with 1.3 billion people is already the world's largest vehicle maker and consumer, and China's production and consumption will continue to grow in

Millennials are likewise reluctant to buy a car depending instead on mass transit or rental vehicles, which are increasingly available.

the future. The United States with more than 300 million people remains the second largest market for cars and trucks after China. (Interestingly, the second largest market in the world for pickup trucks is Thailand.)⁸

And another major foreign market is looming on the horizon—Africa. “Africa’s population is currently at about one billion,” said Gronbach. “As the continent continues to receive the benefits of nutrition, technology, healthcare and education, the average age its inhabitants die will almost double from about 40 years old to about eighty like the rest of the world. This will cause the population to soar as sub-Sahara Africa has high fertility. The real secret to increasing population is keeping people alive. Think of the transportation demands of a continent with 4 billion people. This could easily be the plastics industry’s biggest market ever! ***The plastics industry needs to plan now. A market that grows this fast can easily overwhelm supply.***”

Conclusion

While the overall predictions for light vehicle sales are flat, it perhaps premature to assert that America’s love affair with the automobile is over. It is distinctly possible that the apparent aversion of Millennials to vehicle ownership is a direct outgrowth of the hard times associated with The Great Recession. As more of them launch families, they will experience the need for more living space—suggesting more investment in houses—as well as ready transportation, suggesting a shift back to personal cars and trucks. Much will depend on the strength of the economy in the years ahead. In all scenarios, the demand for plastics in all phases of the transportation industry is expected to remain strong far into the future.

Although Millennials are currently defined by a seemingly different set of priorities—most likely due to economic constraints, and a growing tendency to delay some of the typical adulthood rites of passage like marriage or starting a career—the oldest Gen Yers are just now entering their 30s. As they move more solidly into adulthood and more traditional roles, their buying should exceed that of the baby boomers—a positive outlook for the automotive sector.

In all scenarios, the demand for plastics in all phases of the transportation industry is expected to remain strong far into the future.

⁸ *American Drive* by Richard E. Dauch with Hank H. Cox, St. Martin’s Press, 2012.

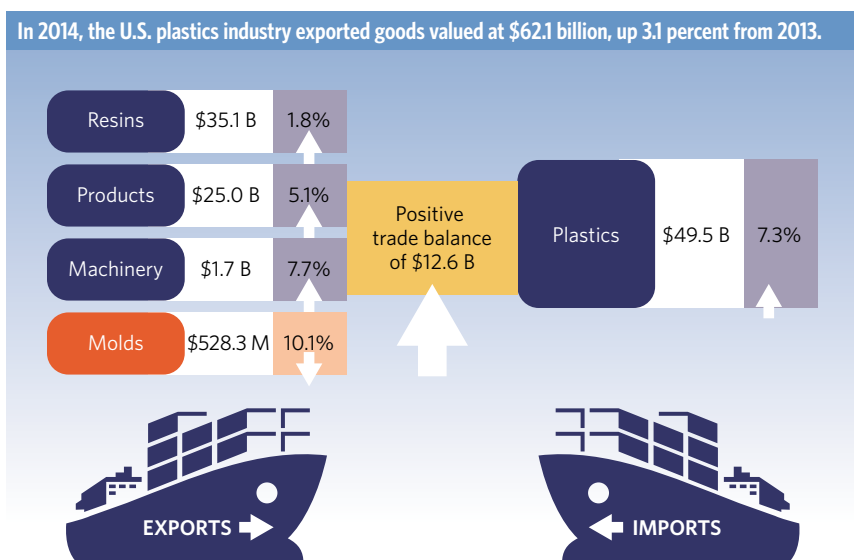
Automotive &
Transportation



Policy
Trends

Policy Trends

As we embark on 2015, we are poised at a key moment. The Republican-controlled 114th Congress will be eager to demonstrate it can do better than the 113th, which was one of the least productive in history, at least in terms of legislation enacted. For his part, President Obama is looking for ways to remain relevant in the remaining two years of his second term in which he is politely regarded as a “lame duck.” Both parties seem determined to get things done. Two policy areas of particular significance for the automotive and plastics industries are international trade and CAFE standards.



International Trade

There is a good chance that Congress and the White House may agree on Trade Promotion Authority, known as “fast track.” Simply stated, fast track says that when an administration negotiates a trade deal, Congress can only vote it up or down, but cannot tinker with it. This is a critical distinction. Once you invite 535 legislators to review trade language, the process immediately bogs down. Every Member of Congress has specific concerns with trade agreements and they all know how to deter action indefinitely. No other country would negotiate with us in good faith if we permitted that to happen.

Today the U.S. government is pursuing two critical new free trade agreements (FTAs), the Trans-Pacific Partnership (TPP) and the Trans-Atlantic Trade & Investment Partnership (TTIP) that have great promise. Given our system and current political environment, passage of “fast track” authority is realistically a pre-requisite for the successful conclusion of TPP and TTIP, both of which the administration is committed to. The countries we are negotiating with are more inclined to reach accord knowing that Congress is likely to ratify the final package.

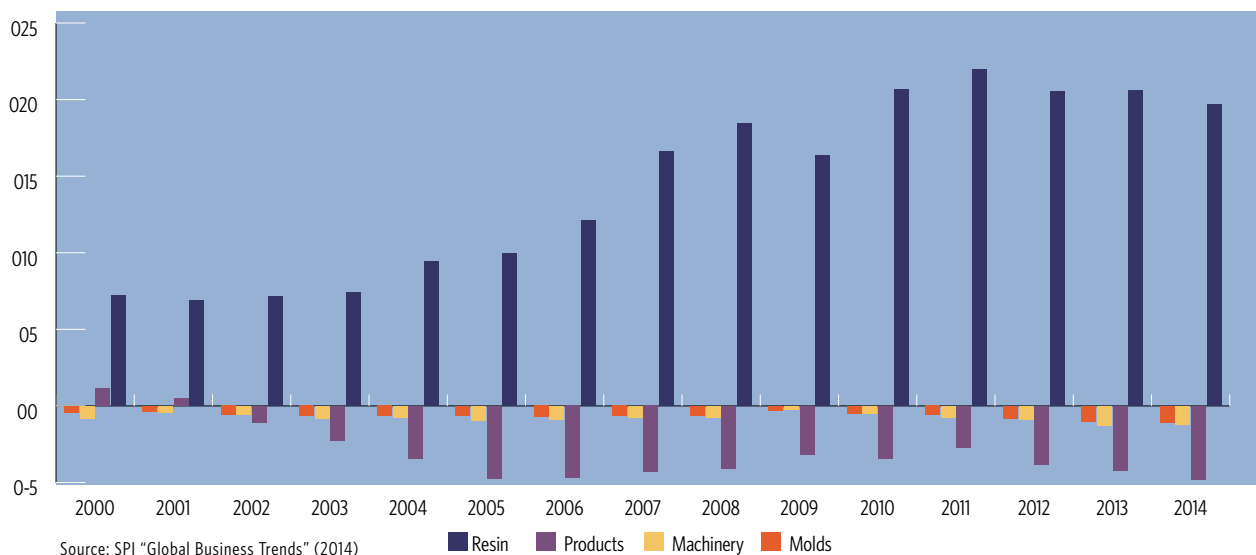
The importance of trade to our economy cannot be overstated. The link between trade and economic growth is clear and unmistakable. Trade deals open new markets to exporters across the economic landscape. More trade stimulates more investment and R&D. It has been estimated that every additional \$1 billion in exports creates another 20,000 jobs. Though that is a rough estimate that depends on the industry in question, there is no question that a rising tide of international commerce fosters major

job creation. Trade is especially vital to mature economies like our own; 95 percent of consumers are not here.

Nor is there any serious question that free trade agreements are a benefit to the overall economy of the U.S. The North American Free Trade Agreement (NAFTA) was highly controversial when it was approved, and still is in some circles, but without question it has given our economy a boost. In 2014, the U.S. plastics industry exported \$15.8 billion to Mexico and \$13.2 billion to Canada. These two countries remain far and away our two largest trading partners.

China is the industry’s third largest export market with exports totaling \$5.2 billion in 2014, or 8.3 percent of total plastics exports. The industry had its largest trade deficit with China—\$7.5 billion, however, this deficit improved

U.S. Plastics Industry Trade Balance by Segment 2000-2014



for the second year in a row. The deficit was most acute in plastics products trade where the U.S. had a \$10.3 billion deficit with China, although this deficit too improved from 2013. These deficit reductions are the consequence of an improved competitive position for the U.S. plastics industry globally.

The U.S. currently has FTAs with 20 countries. Our exports to these FTA partners are up 57 percent since 2009 and 46 percent of all of our exports go to FTA countries. In 2014, the plastics industry showed a \$15.7 billion surplus with our FTA partners.

Free trade is especially critical for the plastics industry, which is heavily committed to the global economy. In 2014, the U.S. plastics industry exported goods valued at \$62.1 billion up 3.1 percent from 2013. The industry showed a positive trade balance of \$12.6 billion up from \$12.2 billion in 2013. The nation's trade in plastics is a bright spot in the overall trade picture. With the likely conclusion of TPP this year, this situation looks to only improve.

The U.S. resin trade surplus has grown strongly in dollar terms because of strength in the U.S. economy relative to

the rest of the world. The cheaper dollar is helping, and light, natural gas-based feedstocks, once a cost burden to the U.S., are now cost-advantaged relative to expensive crude oil based feedstocks used in most other countries. As a result, a new wave of feedstock and resin capacity expansions is happening in the U.S. Whereas U.S. resin exports were once expected to decline as the domestic demand for those resins grew, the new resin capacity now makes it likely that resin export levels will increase rather than decrease.

Back in 2005, experts were predicting that North America could become a net importer of both polyethylene and PET (polyethylene terephthalate) by 2009. This illustrates the impacts of shale gas on the U.S. plastics industry and just how much of a game-changer this development is.

CAFE Standards

Another government policy of particular interest to the automobile industry, and the role of plastics in cars and trucks, is that of Corporate Average Fuel Economy (CAFE) standards. The use of plastics in lightweighting vehicles has proven to be a cost-effective way to help boost vehicle mileage for decades. The Obama Administration has raised the average fuel economy standard of new cars and trucks to 54.5 miles per gallon

Another government policy of particular interest to the automobile industry, and the role of plastics in cars and trucks, is that of Corporate Average Fuel Economy (CAFE) standards. The use of plastics in lightweighting vehicles has proven to be a cost-effective way to help boost vehicle mileage for decades.

by 2025—which is not far away. The fleet-wide standard for cars and trucks is scheduled to rise in 2016 to 37.8 MPG and 28.8 MPG respectively. Plastics can play a critical role in enabling and helping automakers meet the 2025 standards

The much celebrated collapse of oil prices along with the appearance of gas under \$2 per gallon in some places does not directly impact the CAFE standards which are established under federal laws and regulations and are not subject to the vagaries of fuel prices. To be sure, many consumers are shifting back to vehicles such as SUVs that offer lower fuel efficiency, but this phenomenon is likely to be short lived. Oil prices have fallen into the basement often before, but they rarely stay there for long.

Disregarding fuel prices, the 54.5 MPG mandate is deceptive because of the way the government rates fuel economy. That figure is the *average* fuel economy automakers must deliver across the nation's entire vehicle fleet by 2025. With the average age of a fleet exceeding 10 years, that means the new cars rolling off the assembly line have to far exceed 54.5 MPG to meet the government mandate. This will drive innovation into each new redesign of a car over the next 10 years.

However, if the price of gasoline remains low for a sustained period of time, and consumer demand for gas guzzlers begins to influence automaker production plans,



the targets for fuel efficiency can be pared back, substantially if necessary. Already, car companies are laying the groundwork to seek some relief when the targets come up for review by regulators in 2017. But they will likely encounter stiff resistance from regulatory agencies. "There would have to be a hard discussion about letting anyone off the hook," Mark Rosekind, chief of the National Highway Traffic Safety Administration, which helps set mileage targets, told *The Wall Street Journal* in January. The agency's focus, he said, "is going to be on fuel efficiency" regardless of any swings in prices at the pump. And of course if consumer demand for stricter fuel efficiency should increase

for political reasons, unlikely in a time of low gas prices, the mileage targets could actually be increased.

While the basic formula for CAFE standards remains in place and though it may be tweaked if fuel prices remain at historically low levels, the change will probably be modest. There is popular support for fuel efficiency, particularly for the Gen Yers, and little political will to revisit the issue. Consequently, the use of plastics in automobiles and light trucks is expected to continue to grow as the demand for fuel efficiency remains in place and the technology continues to advance, providing ever more opportunities for use of plastic in vehicles.

Conclusion

Public policy issues will impact sales of cars and light trucks, but the focus on energy efficiency and environmental protection is permanently embedded in the nation's culture and it is safe to assume it will continue to encourage a growing reliance on plastics in the future to help light weight vehicles. The current trade policy agenda is an ambitious one with simultaneous ongoing negotiations focused on the Asia with TPP and Europe with TTIP. Especially with the inclusion of Japan in the TPP process, automobiles are in the forefront of consideration. It looks very likely that TPP will get concluded this year. This will understandably provide an economic boost for automobile assemblies and parts.

Public policy issues will impact sales of cars and light trucks, but the focus on energy efficiency and environmental protection is permanently embedded in the nation's culture and it is safe to assume it will continue to encourage a growing reliance on plastics in the future to help light weight vehicles.

Automotive &
Transportation



Technology
Trends

Technology Trends

Plastics and Innovation

Historically, manufacturing has been the seedbed of innovation accounting for two-thirds of private sector research and development and 90 percent of patents issued each year by the U.S. Patent and Trademark Office (USPTO).⁹ Manufacturing is constantly challenged by consumers always demanding better quality at less cost, environmentalists seeking less pollution and more sustainability, and the most intense foreign competition the world has ever seen. The demand for innovation is relentless and the research and development floor is where new ideas are put to the test to see if they are practical and what changes are needed to translate them into action.

The plastics industry is in the vanguard of innovation and nowhere is that more conspicuous than in the automotive/transportation industry. According to the American Chemistry Council's Plastics Division, plastics make up about 50 percent of a modern automobile's volume, but only 10 percent of its weight. As demand for lighter, safer, more

As demand for lighter, safer, more fuel efficient cars and trucks continues to grow, so will demand for technologically advanced plastics components.

fuel efficient cars and trucks continues to grow, so will demand for technologically advanced plastics components. Is an all plastics car in our future? We will have to look to Generation Y engineers for that answer.

One thing is clear—the common perception of vehicles and trucks as rolling hunks of steel is antiquated in the extreme. Likewise, the composition of aircraft, passenger trains and urban metro vehicles continues to evolve toward greater dependence on plastics.

A casual glance at the inside of any modern car or truck shows the interior compartment to be dominated by plastics—instrument panels, interior trim and upholstery. Plastics are also used in lighting, bumper systems, fuel storage and delivery systems, ducts, fenders and exterior body panels, and more and more within engine compartments or other under-the-hood components.

A key driver of increased use of plastics in vehicles is the relentless quest to reduce weight of vehicles in order to reduce fuel consumption. In the U.S. this is largely driven by federal CAFE standards, and as U.S. automakers put greater emphasis on foreign sales it must respond to both regulatory and social demands for greater fuel efficiency.

"Modern cars are increasingly relying on plastics to reduce their weight and maximize fuel efficiency," says Kendra L. Martin, SPI's Senior Director-Industry Affairs.

"This year's Auto Show in Detroit was filled with an exciting array of vehicles taking advantage of material innovations and evolving structural capabilities made possible by the use of plastics."

The adoption of plastics into cars and trucks has been an evolutionary process over the past few decades that continues to accelerate. The challenge initially was to develop plastics with tensile strength comparable to that provided by metal. The true revolution in plastics began with the development of engineering thermoplastics that led to polyamide, polyacetal and polycarbonate. From there engineers learned to "blend" different plastics, creating new materials with useful combinations of which one was thermoplastic olefin (TPO), which has a bit of rubber in it to give it elasticity. A variety of plastic blends are used for structural parts, electronics, household and automotive items that depend on heat resistance, dimensional stability and accuracy.

In the early days, most plastics were not stiff enough for many automotive uses, so researchers began adding glass fibers and other fillers to injection molded plastics to give them more rigidity. A variety of new plastics provide extraordinary new capabilities. For example, polycarbonate resin is an amorphous engineering thermoplastic, characterized by outstanding mechanical, optical, electrical and thermal properties. These polycarbonates provide broad design versatility through a wide range of viscosities and product options such as:

⁹ *Can American Manufacturing Be Saved*, Michelle Nash-Hoff (2012).

environmentally conforming flame retardancy, scratch resistance, toughness, heat resistance, weatherability, biocompatibility, optical quality, and compliance with stringent Food and Drug Administration (FDA) and USPTO requirements. Polycarbonate is the material in bullet-proof “glass”.

Compression plastics—or thermoset plastics—are molded with heat and pressure into a rigid form, with the smooth and rigid look of sheet metal. Most plastic is stable up to about 150–160 degrees Fahrenheit, but then begins to lose some of its properties. That is not a key issue for decorative uses, but becomes a problem if the plastic component is load bearing. Thermosets can be more amenable to heat, but the end product has additional weight and other issues that begin to compromise a key advantage of plastic. However, new variations coming online promise to address the weight and other problems that may develop.

Plastics engineers work closely with automobile and truck designers to provide plastic components uniquely adapted for specific uses. Today there are literally hundreds of core plastics and the variations of each translate into literally thousands of options, with more being developed every day. To the engineers, it is a daily challenge to figure out which plastic or plastic variation is ideal for specific uses, and to define where new products are needed.

Plastics have contributed many innovations in vehicle safety, performance and fuel efficiency. Seat belts alone, made from durable strands of polyester fiber, help save 11,000 lives each year, according to the National Highway Traffic Safety Administration (NHTSA). Airbags, commonly made from high-strength nylon fabric, can reduce the chances of dying in a direct, frontal car crash by about 30 percent according to NHTSA. Also, child safety seats which are made

possible by numerous advancements in polymer science have greatly reduced the incidence of childhood injuries in automobile accidents.¹⁰

Plastics today are largely found in the exterior and interior of automobiles and trucks but are increasingly being used in the engine compartment where the incessant explosions of the internal combustion engine generate tremendous pressure and heat. Likewise, the axles and drive trains of modern vehicles, though increasingly complex, remain places where metal on metal creates tremendous heat and stress. There is at present very little presence of plastics in axles and drive trains, but that is changing. A major imperative in the evolving world of automobiles and trucks is noise suppression, and plastics and rubber offer promise for the future.

However, there are many functions under the hood that do not necessarily embody the stress and heat of the combustion chambers or transfer of torque of the axle assemblies. Plastics engineers are working together to increase use of plastics in other systems, integrating injection and low pressure molded parts, and harnessing plastics and elastomers that offer a range of properties from “soft” to “hard.” These technological-advanced parts can be molded simultaneously or in sequence, offering a



better product without expensive assembly work. Functional under-the-hood components are molded from engineered resins such as ABS, glass-filled Nylon, PET, talc-filled polypropylene and a variety of talc and glass filled materials.

Plastics are also beginning to make a significant contribution to the structural makeup of the vehicle. Intensive development of thermoplastics has opened the way for production of post-decorated parts to meet the high temperature of the paint curing ovens used by the automotive industry, and electrically conductive grades, for electrostatic painting. All of the plastics conduct electrical charges at varying degrees.

Disruptive Technologies

Rapid fire advances in plastics correspond to an invasion of disruptive technologies into the modern manufacturing workplace. The robots are here. It isn't just science fiction anymore. Across the manufacturing landscape, robots are becoming ubiquitous. This has been happening gradually over several decades, but now the pace is accelerating. Initially, most robots were designed to do the drudge routine work—dangerous and dirty jobs—like welding and spray painting. They tended to be ugly, bulky, bolted to the floor and screened off to protect workers.

But advanced robots, like advanced manufacturing itself, is a new animal altogether. They have enhanced senses, dexterity and intelligence—made possible by advances in machine vision, artificial intelligence, machine-to-machine communication, sensors and actuators.

¹⁰ Lives Saved Calculations for Seat Belts & Frontal Air Bags, NHTSA, December 2009.

Plastics in Automobiles

Plastics are broadly integrated into today's lifestyles, and make a major, irreplaceable contribution to virtually all product areas—including transportation. In automobiles especially plastics have assumed a dominant role because of their strength, light weight, relative cost, resistance to rust and durability.

WHO BUYS CARS?

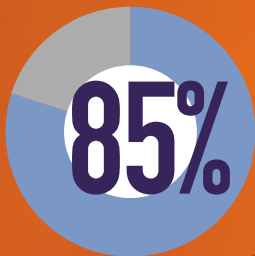
43
year old men
buy more new cars
than anyone else

ECONOMIC TRENDS

250
million
vehicles on the
road in the U.S.

Plastics
is the **third**
largest
industry

91%
of U.S. manufacturers
are **optimistic**
about their company's
outlook for 2015



of U.S. plastics
are made from
shale gas

16.8 M
Anticipated sales of
**autos &
light trucks**
in 2015

Overall consumption of plastic
goods in the U.S. grew



\$251 B → **\$267.3 B**
2012 → 2013

WHO DRIVES?

Less than **80%** of people aged **20-24** today have a driver's license

80 million

Baby Boomers show **no signs** of reducing driving habits

Domestic businesses ship & receive **63 tons** of freight per year on average for **every man, woman & child** in the country

The **average person** travels more than **13601 miles per year** (by all modes of transportation)

CAFÉ STANDARDS



50% of a modern vehicle's **volume** is plastics but only **10%** of its **weight**

Corporate Average Fuel Economy

The use of plastics in **lightweighting vehicles** is a **cost-effective** way of **boosting** vehicle mileage



Average fuel efficiency for **new cars & trucks** by 2025

SAFETY IN PLASTICS

11,000 **30%**

lives saved annually by made from **seat belts** durable strands of **polyester fiber**

Reduced chance of dying in a **head-on collision** due to airbags, commonly made of **high-strength nylon fabric**

TECHNOLOGY

2030 Automotive industry will recognize **plastics & polymer composites** as preferred material for automotive & **sustainability** requirements

The time it took **Strati** to create a **3D printed car** at the **International Manufacturing Show**

The future is **additive manufacturing**—or **3D printing**

The new robots are smaller and more compact than the earlier generation. They are easier for workers to co-exist with and communicate with. So we are seeing more and more robots appear on the shop floor working alongside humans. They are also showing up in a growing number of service jobs, such as cleaning and maintenance.

We all accept the reality that machines can be built to perform rote physical tasks, but what about jobs that require active thought? Every day brings more intelligent software systems that can perform knowledge work tasks involving unstructured commands and subtle judgments. Advances in artificial intelligence, machine learning, and natural user interfaces—such as voice recognition—are making it possible to automate many knowledge worker tasks that have long been regarded as impossible or impractical for machines to perform.

Machines are not only learning to listen to us, and talk to us, but they are learning to converse with each other. In the past five years, we have seen a threefold increase in the number of mechanical devices communicating with each other even as the cost has declined dramatically.

This is the Internet of Things (IoT)—embedded sensors and actuators in machines and other physical objects to bring them into the connected world—that is spreading rapidly. This can involve monitoring the flow of products from an assembly line, measuring the moisture in a field of crops, or tracking the flow of water through utility pipes. The IoT allows us to manage assets, optimize performance and create new business models. It also offers great promise in health care by facilitating monitoring of people with chronic health problems.

An offshoot of the advances in robotics is advances in vehicle controls for cars, trucks, aircraft and boats rendering them virtually independent of human control. We have all seen reports of the drones on the battlefield, and Google's self-driving car that has racked up more than 500,000 miles without an accident. The technologies of machine vision, artificial intelligence, sensors and actuators that make these machines possible are rapidly improving.

Over the next decade, the experts say we will be seeing low-cost, commercially available drones and submersibles used for a wide range of applications. Autonomous cars and trucks could enable a profound revolution in various modes of ground transportation—depending on public acceptance.

3D Printing (additive manufacturing)

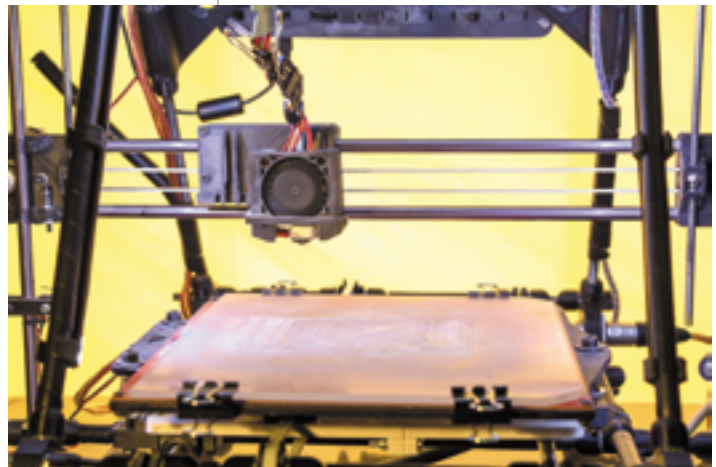
One of the most dramatic breakthroughs in plastics technology in the automobile/transportation industry is that of 3D printing, also known as additive manufacturing. Traditionally, most standard products are created by subtractive manufacturing in which masses of raw material such as steel, wood or ceramics were cut and formed into the desired shape. In contrast, 3D printing creates desired products by adding layers of polymer or other substances in thin accurate layers one at a time specifically to the shape desired.

The primary use of 3D technology in the automotive/transportation industry today is to get a part in your hands for design validation before you invest all the resources it takes to build a mold. If you need more copies, it is more cost effective to build

one silicone mold from a single 3D part and then cast duplicates than to build 20-30 3D parts. Before 3D, it generally took several weeks if not longer. Today the CAD designer creates the math data and sends it to the 3D department where it is downloaded into the 3D printer. The part can be ready in as little as a few hours. The abbreviated process, called a "Godsend" by Peter Bondy, director of strategic development for Advantage Engineering, saves countless hours and huge sums of money.

At present, 3D printing is not in widespread use making specific components for cars and trucks in production because it cannot match the speed of traditional production machines (though they are used in some low volume production). However, there are limited examples of 3D printing being used in production. In the aerospace industry, metal parts are often machined from a solid billet of costly high-grade titanium, most of which is cut away and wasted. With a 3D system, titanium powder can be used to print things like a bracket for an aircraft door or part of a satellite, using only 10 percent of the material. Still, it may be years before we see 3D printing actually create working components for vehicles.

3D printing may have even more potential than previously imagined for



the plastics industry. An innovative company Carbon3D—consisting of chemists and physicists—have come up with a new process they call “continuous liquid interface production (CLIP) technology that places a pool of resin over a digital light-projection system. A window between the resin and light allows both light and oxygen to travel through. To create an object, CLIP projects specific bursts of light and oxygen. Light hardens the resin and oxygen keeps it from hardening. By controlling light and oxygen exposure in tandem, CLIP can make intricate shapes and lattices in one piece instead of the many layers of material that usually make up a 3D printed object.

Nanotechnology

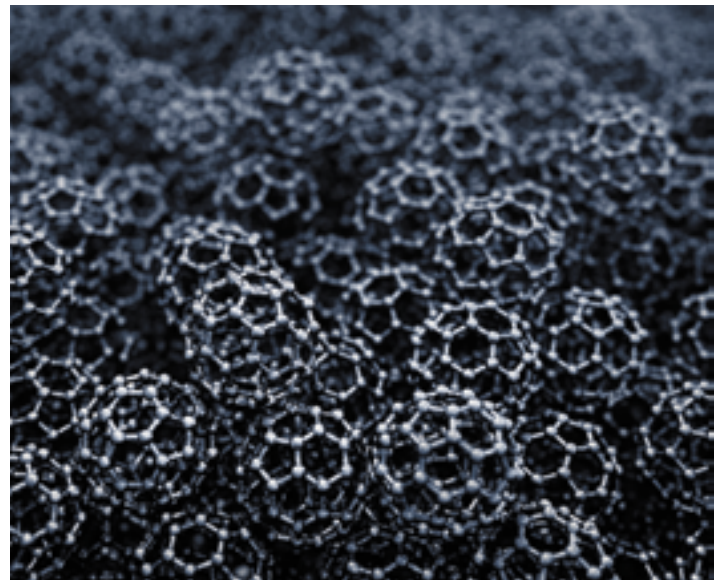
Nanotechnology is the study of matter at an incredibly small scale and the plastics industry has not overlooked it. Nanotechnology has made plastics stronger and more versatile. A nanometer (nm) is one billionth of a meter. To put that in perspective, the comparative size of a nanometer to a meter is roughly the same as that of a marble to the size of the earth. Put another way, a nanometer is the amount an average man’s beard grows while he lifts a razor to his face.

The ability to manipulate substances on the nano scale opens a wide range of possibilities including the application of plastics to automobile parts. Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macroscale, enabling unique applications. For instance, opaque substances can become transparent (copper); stable materials can turn combustible (aluminum); and insoluble materials may become soluble (gold). A material such as gold which is chemically inert at normal scales can serve as a potent chemical catalyst at nanoscales. Much of the interest in nanotechnology

is based upon these fascinating quantum and surface phenomena that matter exhibits at the nanoscale.

The potential applications of nanotechnology to plastics used in the transportation industry are virtually limitless. Nanotechnology can make plastics

stronger and more versatile. It is now being used in the plastics industry clearly with revolutionary properties—lighter, stronger, more rigid and with greater conductivity. It may also lead to revolutionary plastics that are less sensitive to temperature fluctuations.



Carbon Fiber Technology

In mid-2014, BMW introduced an electric car in the U.S., the i3, the first mass produced vehicle with a major component—the passenger compartment—made entirely from carbon fiber-reinforced plastics (CFRP). Carbon fiber is an incredibly small diameter fiber made mostly of carbon atoms. They are typically bundled to form a thread that is woven into fabric. The material has been used before but mainly in upscale vehicles because it was expensive to produce. After years of research, BMW has been able to mass produce CFRP which is 10 times stronger than steel and 30 percent lighter than aluminum.

The process of combining carbon fiber with plastics is similar to adding rebar (reinforcing bar) to concrete to create reinforced concrete. The combination results in materials with superior qualities, such as greater strength and durability. The reduction in weight of 10 percent can increase fuel efficiency up to 8 percent over the lifetime of the vehicle.¹¹ CFRP components also have a much higher energy-absorption rate than steel which can mean more safety in a collision.

Recent breakthroughs in research are expected to eventually catapult CFRP into the mainstream, making them much cheaper and faster to produce. The plastics industry is helping fund research to enable automobile parts makers to predict the performance of plastic composite parts that use long, lightweight glass fibers in fast-cycle manufacturing. Such predictability can speed up manufacturing and bring down costs.

Long Term Concerns Related to R&D

In the long term, there are troublesome signs; as a growing number of companies are sinking profits into stock buybacks, corporate acquisitions and mergers and other short-term plans that do not create wealth and do not augur well either for the long-term prospects of the companies or the nation’s economy.

¹¹ American Chemistry Council.

And virtually all manufacturers report growing difficulties attracting talented young people into careers in industry. This growing skills gap threatens to become acute as a rising tide of baby boomers move into retirement. Long-term growth depends upon capital investment, R&D and development of a 21st century workforce which in turn is driven by a belief in the future and willingness to take risks.

Recycling

On the recycling front, a substantial amount of the plastic used in new cars itself is recycled material, ranging from recycled polyurethane foam plastic in seat cushions; plastic caps and bottles to make radiator shrouds and air deflectors; and, plastics recycled from bumpers to create new bumpers. And while the recycling of automotive plastics is in its infancy, each year nearly all of the 27 million cars around the world that reach the end of their useful lives are recovered for recycling. There is such a variety of current initiatives and potential opportunities in this area, a stand-alone report looking at recycling and bioplastics use in the automotive sector will be published by SPI later this year.

Conclusion

“By 2030,” says the American Chemistry Council, “the automotive industry and society will recognize plastics and polymer composites as preferred material solutions that meet and, in many cases set, automotive performance and sustainability requirements.”

At the International Manufacturing Technology Show at McCormick Place in Chicago last September, visitors watched in awe as the first working 3D-printed vehicle called the Strati was created from scratch in 44 hours—layer by layer until the attending engineers simply got in and drove it off the floor. It was a first but it will not be the last. We are riding the power of innovation into a new age of accelerating productivity that other countries will be hard-pressed to match.

Stated another way, the prospect of 100 percent plastic automobiles and trucks on the road is increasingly plausible—because prototypes are already on display in R&D facilities and in some trade shows. The plastics industry, ever and always in the front ranks of innovation, is on the leading edge of this movement.

Innovation is a principle catalyst of long-term economic growth and global economic competitiveness. Intellectual property (IP) is the by-product of innovation and intellectual property rights incentivize and protect innovation in a society. In March 2012, the Economics and Statistics Administration

(ESA) and the U.S. Patent and Trademark Office (USPTO) of the U.S. Department of Commerce identified IP-intensive industries and examined their characteristics and contributions to the overall economy. To be specific, their report identified 75 industries (from among 313 total) that are particularly dependent on patent, copyright, or trademark protection and which they define as IP-intensive.

This report identifies industries by North American Industry Classification System (NAICS) codes. Two NAICS codes determined to be IP-intensive were 3252—Resin, rubber, and artificial fibers and 3261—Plastic products manufacturing. These two represent core segments of the plastics industry.

The prospect of 100 percent plastic automobiles and trucks on the road is increasingly plausible—because prototypes are already on display in R&D facilities and in some trade shows. The plastics industry, ever and always in the front ranks of innovation, is on the leading edge of this movement.

Automotive &
Transportation



Labor
Trends



The shortage of highly-skilled manufacturing workers could worsen to approximately 875,000 machinists, welders, industrial-machinery mechanics and industry engineers by 2020.

Labor Trends

Most sectors of the expanding plastics industry are producing a steady stream of new job opportunities. However, there is a critical lack of skills among applicants for work in most phases of the plastics industry. The industry could be producing even more jobs if there were enough qualified applicants to fill them.

"The shortage of highly-skilled manufacturing workers could worsen to approximately 875,000 machinists, welders, industrial-machinery mechanics and industry engineers by 2020," said Conrad Bessemer, President of Novatec, Inc. "Every SPI meeting brings more testimony of companies in the plastics industry lamenting their inability to find skilled talent. They tell their stories of work-arounds—like hiring unemployed physicists to setting up a paid internship so a foreign national from the home office can come to the U.S. to allow work on an important project to go forward."

David Preusse, president of Wittmann Battenfeld, Inc., in Torrington, Conn., has taken an aggressive approach to attracting new talent into the company, hosting an open house at its headquarters. "The interest is there," Preusse said. "We were expecting between 60 and 80 people and got more than 200. People went to different stations and learned how we program out robots, micro-molding and material handling, and each person that they came to see introduced themselves and said a bit about their history with the company. There are

so many things that the younger generation doesn't know about plastics and doesn't know about careers in plastics and manufacturing. Open houses invite them to learn something that they otherwise wouldn't have about a field that's growing, innovative and, frankly, pretty cool."

"In my 51 years in the automotive industry I have never experienced such a shortage of trades' people and I have to say we are doing a poor job of rectifying it," said Peter Bondy, director of strategic development for Advantage Engineering. "The allure of college degrees has replaced the trade school encouragement, especially at a high school level. No longer do we see recruitment for young students to enter the metal and plastics working arenas. With today's equipment it is a far cry from the tool shop environment a lot of us knew. Today, women have the same advantage as men in the tool shop as everything is highly automated and electronically controlled."

"Years ago, the immigration of European tradesmen into the North American continent looking for the American dream provided a healthy base of good teaching leaders in our shops," said Bondy. "Well, they have all but retired and we have failed to shore up their knowledge base with our educational facilities. I know we are working hard at trying to fix this situation but there has to be more collaboration between the college level and the trades programs."

According to Laurie Harbour of Harbour Results, Inc., the average tooling maker in the U.S. today is 56 years old. The growing skills gap in the plastics industry is a reflection of an even greater challenge endemic to the full spectrum of manufacturing. During the first decade of the new century, U.S. manufacturing lost about 5.7 million jobs. The great majority of these jobs were low skill, repetitive motion jobs that were doomed to extinction regardless of what policies the government pursued. As the world evolves into one great global marketplace it is simply not possible to pay generous wages for unskilled labor and remain competitive. The world is changing and the U.S. must change with it if we are to maintain our standard of living and position of global leadership.

At the same time, it must be recognized that the loss of those 5.7 million jobs delivered a severe blow to the nation's economy from which we are only now beginning to recover. But the manufacturing crisis bottomed out, as crises always do. Since February 2010, U.S. manufacturing has added more than 700,000 jobs, the fastest pace of job

**One thing is clear—
the common perception
of vehicles and trucks
as rolling hunks of
steel is antiquated in
the extreme.**

growth since the 1990s.¹² This does not replace the 5.7 million manufacturing positions lost, but they are for the most part better jobs than those that are no longer available. Also, manufacturing jobs support numerous jobs in other sectors so the overall outlook is much greater than the bare numbers would indicate.

The new manufacturing jobs are significantly different from the rote assembly line work of earlier generations. The new manufacturing is built upon advanced technologies that demand more advanced skills from workers. They must be able to grasp engineering concepts, work with computers, make mathematical calculations and adapt to constant change. A manufacturing worker today must have the equivalent of two years of college, usually more, and the bar keeps rising.

Changing Requirements

Along with disruptive technologies comes disruption in skills requirements," said Stacey Wagner, Principal of the JarrettWagner Group, LLC, a leading expert in helping manufacturers develop worker skills. "New requirements take some time to fully understand and to teach—once they have been identified."

This may be the main problem facing modern manufacturing—why finding qualified employees is so difficult. The American Small Manufacturers Coalition says that while almost 77 percent of manufacturers rate the importance of human-capital acquisition, development and retention as highly important to their business success, only 24 percent have a measurement system for reviewing the return on their workforce investments.

Wagner says that attitude is way out of date. "Today's advanced manufacturing workplace requires employees with a multitude of advanced technical skills, as well as emotional intelligence, communication facility, talent in cognition and analysis, imagination, a capacity for systems thinking and creativity in problem solving," she said.

This suggests we are barking up the wrong tree in terms of trying to endow workers with specific skills for manufacturing. The technology is advancing so quickly that by the time the workers report for duty, their skills are already obsolete. What we need is a diverse curriculum that empowers people to quickly adapt to changing technology—to stay ahead of the curve.

Without question, the foundation of that curriculum should and must be a strong focus on the STEM subjects—

science, technology, engineering and mathematics. We may not know exactly what game-changing technologies will next appear on the manufacturing scene, but workers well-grounded in the STEM subjects will be uniquely qualified to master them.

Science is increasingly a force in modern manufacturing. The factory floor is replete with scientific processes that involve the composition of various metals and how they interact with each other. Nanotechnology is unleashing vast possibilities for new products and processes that would not have been imaginable even a few years ago. For example, we are after many years finally learning how to weld aluminum to other metals. And each day brings news of fresh innovations in plastics and their applications.

Technology speaks for itself. The digital revolution is rapidly remaking every phase of manufacturing from the front office to the factory floor. Engineering and mathematics are closely intertwined with advances in technology. Workers in advanced manufacturing must have a deep comprehension of basic engineering and mathematical concepts.

Of course, the focus on STEM subjects must begin early in education—preferably the elementary grades. There are various initiatives underway to put more prominence on STEM, but the business community has a critical role to play in terms of working with local school systems to assure a proper emphasis is placed on STEM subjects, and developing programs in which young people get to visit real modern manufacturing workplaces to see how challenging and exciting they really are.

A New Paradigm

Today as always the act of transforming raw materials into finished products generates jobs in mining, transportation, energy, technology and a host of other areas. In the final analysis, manufacturing is crucial to job creation. This is not an irrelevant dispute over economic semantics. The perception that manufacturing employment is withering away fosters misunderstanding and is a

The technology is advancing so quickly that by the time the workers report for duty, their skills are already obsolete. What we need is a diverse curriculum that empowers people to quickly adapt to changing technology—to stay ahead of the curve.

¹² Boston Consulting Group.

crucial factor in our government's reluctance to invest serious time in manufacturing issues. It is simple enough to argue that manufacturing is critical to our economy, which it most assuredly is, but it is the human numbers that ring a bell with politicians.

But business is not sitting on its hands. Community colleges have become a major provider of manufacturing skills. Likewise, there is a host of private programs out there addressing this challenge in this area. The Manufacturing Institute has a highly-praised program called Dream It, Do It, which is now operating worker training programs in 36 states. They work with local schools, community colleges, businesses and community groups to train candidates to work in industries specific to their communities. There are other similar programs out there doing great work in

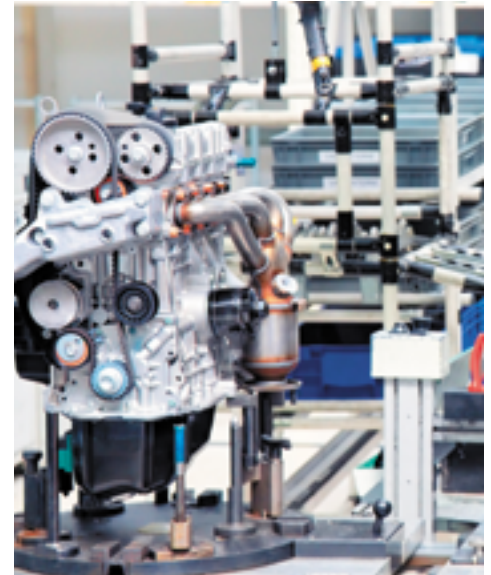


this area. For the manufacturing renaissance to truly take hold, we must have a new generation work force that can handle the technology.

Closing that gap—putting qualified people into advanced manufacturing jobs—will strengthen manufacturing, spur economic growth, and provide excellent opportunities to a new generation of manufacturing workers. The plastics industry in particular has a strong interest in developing a new system for preparing young people to work in industry. To make

this happen, we must address both the demand and supply sides of the equation—identifying where the demand for manufacturing workers is today and supplying the skill sets that applicants need to acquire those jobs.

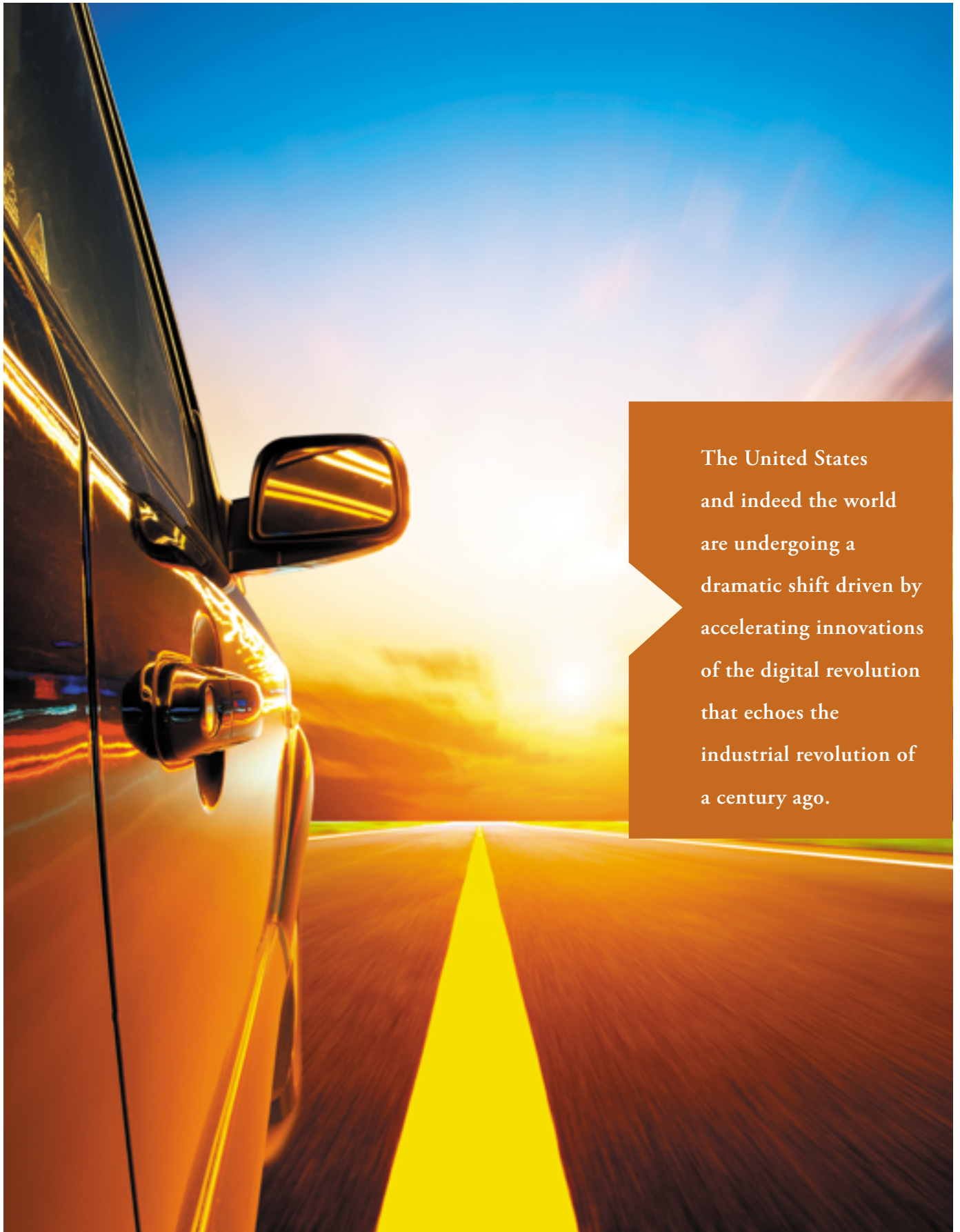
We must begin with understanding that the shift to high-tech work processes and more demanding work is the dominant trend in U.S. manufacturing, and a promising one. McKinsey Global Institute estimates that 35 percent of manufacturing employees are today engaged in services that range from logistics to design, research and development, and of course information technology. By any definition, the new manufacturing is a rich mother lode of career opportunities. A key driver of this transition has been a steady drumbeat of innovation in digital, robotics, biotech, additive manufacturing, materials and energy technologies. The plastics industry in particular is the scene of accelerating innovation as new compounds with extraordinary properties are being developed.



Clever exploitation of the Internet enables modern manufacturing to discern what consumers want, and to efficiently procure the supplies and parts needed for production much more quickly than in the past. To react quickly, a modern manufacturer needs production facilities close by, not the other side of the world. The technological and distribution revolution has also created incentives for more manufacturers to bring production back home—what is now called re-shoring. Higher production costs overseas—including higher wages and benefits and more attention to safety and environmental concerns, along with a shorter shelf life for many new consumer products—are making outsourcing an out of date idea. The Boston Consulting Group estimates that in 2014 up to half of all manufacturers brought at least some of their production back to these shores.

Conclusion

The skills gap afflicting all of manufacturing in the U.S. is equally, if not more applicable, to the plastics industry. Already, many individual companies are working with local schools to make young people aware of the exciting opportunities that abound in plastics and the basic skills and knowledge they need to take advantage of them. There is a great need for more extensive work in this area. It is unlikely that the existing education-training establishment will, on its own, provide the critical labor skills needed in the plastics industry. It is incumbent upon people in the industry that they take the initiative, study what other companies are doing, recognize the learning differences of the next generation, and become actively engaged.



The United States and indeed the world are undergoing a dramatic shift driven by accelerating innovations of the digital revolution that echoes the industrial revolution of a century ago.

Automotive &
Transportation



Culture
Trends

Culture Trends

One of the worst kept secrets in the auto-truck industry today is the use of fake engine noise to emulate the guttural roar long associated with high-performance vehicles. Modern vehicle engines are of higher quality than in earlier years and much more fuel efficient, and one of the side effects of technological advances is less engine noise. The robust engine growl of a modern Ford Mustang or F-150 pickup truck, or a host of other models made by other companies, is concocted by special pipes used precisely for that purpose, and in some cases added by digital sound effects. For the Ford 2015 Mustang Eco-Boost, Ford sound engineers and developers worked on an “Active Noise Control” system that amplifies the engine’s purr through the car’s speakers.

Volkswagen uses what it calls a “Soundaktor,” a special speaker that resembles a hockey puck to play sound files in the GTI and Beetle Turbo. Lexus worked with sound technicians at Yamaha to more loudly amplify the noise of its LFA supercar toward the driver’s seat. Others include Porsche use noise-boosting tubes to crank up the engine sound inside the vehicle cabin. BMW goes a step further playing a recording of its engines through the car stereo system. The sound varies according to the engines load and power exertion.

But wait! There are a host of reasons for this erosion of dependence on and fascination with personal vehicles—the main one being economics.

This “innovation,” if that is the correct term, is lost on many—if not most—consumers. One of the most attractive features of the Toyota Prius and other hybrid vehicles, including the new generation of all-electric vehicles such as the Chevy Volt, is their virtually silent operation. But even then the virtual silence of electric cars can be a problem in that they need fake engine sounds to alert pedestrians that there is a vehicle nearby.

But it is the fake noise in muscle cars that is causing a stir among certain vehicle purists who view it with disdain. They don’t want fake power and they don’t want fake noise. It just doesn’t seem right somehow.

The controversy about fake engine noise serves to underscore an important reality that can get lost amid reports of declining use of automobiles and trucks. Reports that this nation’s fascination with the automobile culture is on the wane, assuming they are valid, need to be put in perspective. For the vast majority of Americans, cars and trucks are still very much a part of daily life and also an expression of cultural values. Millions are still wedded to the muscle car mentality and crave the noise that goes with it.

To be sure, the data are disquieting to those in the industry. The share of young people with drivers’ licenses in the United States has fallen since its peak of 92.2

percent in 1983 to 79.7 percent in 2011. The drop-off was largest for teenagers cresting at 72 percent in 1983 and falling to 50.9 percent in 2011. The overall use of cars and trucks per capita in terms of vehicle-miles traveled peaked in 2004 at just over 10,000 and has declined to about 9,500. The overall estimated vehicle miles driven on all roads by all age groups peaked in June 2005 and had fallen 8.6 percent 87 months later. It is fair to say that the big picture of vehicle use shows the bloom is off the rose and the statistics confirm a steady decline across the board.¹³

But wait! There are a host of reasons for this erosion of dependence on and fascination with personal vehicles—the main one being economics. Politicians and economists today are debating an unfortunate and troubling polarization of American society along economic lines. The middle class seems to be losing ground while a minority at the top of the pyramid is accumulating vast wealth. Though the nation is at long last pulling out of The Great Recession, and unemployment is back under 6 percent, wages remain stagnant for most working people, and economic anxiety is still prevalent.¹⁴

The United States and indeed the world are undergoing a dramatic shift driven by accelerating innovations of the

¹³ U.S. Department of Transportation/U.S. Census Bureau.

¹⁴ “America’s wealth gap between middle and upper income families is widest on record,” Richard Fry and Rakesh Kochhar, Pew Research Center, December 17, 2014.

Industry Drivers of Profitable Growth

- **Innovation and technology**
 - Dramatic changes to the automobile
 - Light weighting and part commonization initiatives will provide opportunities for plastics processors
- **Effective commercial relationships, especially related to**
 - Pricing and costing transparency (including resin cost management)
 - Engineering, technical support, warranty responsibility
- **Fewer and combined vehicle architectures**
 - Drive up production volumes for suppliers, but reduce the number of suppliers
 - Investing in targeted vehicle platforms will be critical to long term growth
- **Manufacturing launch efficiency**
 - Growing number of vehicle introductions each year
 - More extensive supplier technical support required
- **Geographic growth strategies crucial to OEM support...China, Brazil, Russia, Mexico and many other emerging markets**

digital revolution that echoes the industrial revolution of a century ago. In that earlier transition, the United States was transformed from an agricultural society into an industrial society. In the mid-19th century, more than 64 percent of the American people lived and worked on farms. Today, about 2 percent work on farms—producing far more food more cheaply than the 64 percent did not long before.¹⁵

The industrial revolution created vast wealth that eventually raised most everyone's standard of living. But for a long time the lion's share of the new wealth was going to a relatively small number of people while the masses of humanity lived close to the edge and were frequently thrown into abject poverty when the economy went into recessions. It took many long years and a great deal of social disruption before a confluence of forces—mainly organized labor, government social programs and expanded educational opportunities—blunted the rough edges of modern industrialization and provided a more solid footing for a substantial middle class to develop.

When that middle class truly came into its golden age—in the years after World War II—it's most conspicuous and transformative expression was the automobile. Cars

were gradually working their way into mainstream life in the 1920s and 30s, but in the 50s they evolved into something more than basic transportation. They became glamorous and eye-catching expressions of an individual's place in the world. To own a car was a personal statement of achievement and position in society. Older people indulged themselves with large expensive sedans like

Buicks, Oldsmobiles and Cadillacs. Younger sports expressed their rebellious lifestyles with Thunderbirds and Corvettes. But just about every young person who came of age—usually 16—made a beeline to the local Department of Motor Vehicles to obtain a driver's license, even if they did not own a car. To be able to drive a car conferred status and mobility. It was for most people a profound expression of the American dream. To not have a car was something of a stigma, at least for many.

The power of the automobile was and remains a statement of freedom. In the mid-1950s, a group of American's sympathetic to communism travelled to the Soviet Union bearing a copy of the 1940 film "The Grapes of Wrath," based on the famous novel John Steinbeck, in which impoverished farmers, a family named Joad, from the Dust Bowl set out on a trek to California. (Henry Fonda was the star.) It is considered one of the great American stories of poverty and the visitors thought it would bring cheer to the Soviet people to know that their quest for economic justice had echoes in the United States. But the result was not what they intended. The Soviet audiences were astounded not only that people in America had their own personal vehicles, but that they could just get up and move around the country on their own without government permission. That bleak movie was to them a message of freedom and prosperity—and it was based upon the social and economic mobility provided by the automobile.

Today the automobile—the Joads from *The Grapes of Wrath* actually had a pickup truck—remains a powerful statement of American culture, and it also remains a powerful economic force.

The power of the automobile was and remains a statement of freedom.

¹⁵ The Voice of Agriculture, American Farm Bureau Federation.



The majority of drivers and their respective key trends suggest a growing automotive and transportation market, and a market where the overall use of plastics has a good chance of increasing.

Automotive &
Transportation

Conclusions

Conclusions

In summary, the predictions for light vehicle sales in North America from 2016 through 2027 track with what this report has identified as the major market forces. The majority of drivers and their respective key trends suggest a somewhat flat automotive and transportation market, but a market where the overall use of plastics has a good chance of increasing. A notable force working counter to this would potentially be the increasing entry of Millennials into the labor pool and how their preferences might change

Given the inherent advantages that plastics represent compared to other alternative materials, it is extremely likely that the transportation choices of the future will use more, not less.

(or not) as they age. A second category of potentially negative forces includes a standard list of known risks surrounding political and economic uncertainties. This list includes domestic political gridlock, negative developments among our chief trading partners (i.e., China, the Euro Area, and Japan in particular), as well as explosive foreign policy situations like Syria, Ukraine and ISIS.

As for the rise of the Millennials and what that ultimately means for the automotive and transportation market, it seems plausible that as they age, form families, and increase in their disposable incomes, there will be some who adjust

their initial generational preferences when it comes to transportation choices. Certainly, increased urbanization and the greening of the consumer will work against changes in these initial preferences. As we know, however, the Millennials are not the only consumer strata of importance as far as buying preferences are concerned. Continued immigration is also important to keep in mind as many of the immigrating groups are focused on achieving the traditional American dream, which includes owning an automobile. Many of these immigrant groups bring with them an as yet unfulfilled love affair with the automobile.

Earlier this year, the American Enterprise Institute, the Brookings Institution, and the Center for American Progress released a report titled, "States of Change: The Demographic Evolution of the American Electorate, 1974-2060." This study identified some transformative trends that are relevant here.

1. The rise of minorities—and decline of whites. In 1980, 80 percent of the U.S. population was white. Now, it is 63 percent; by 2060, it's projected to be around 44 percent.

■ Meanwhile, Hispanics have gone from 6 percent in 1980 to 17 percent and are projected to reach 29 percent by 2060. Asian Americans (and "others") are expected to double from 8 percent now to 15 percent by 2060.

■ The proportion of African Americans, now 12-to-13 percent, is estimated to stay stable.

2. Generational shifts—The World War II generation is mostly gone (it is 1 percent of the total population). And baby boomers, born between 1946 and 1964, no longer dominate. They represent 24 percent of today's population, slightly behind "Millennials," born from 1981 to 2000, at 27 percent, and slightly ahead of Generation X, born from 1965 to 1980, at 21 percent.

The rise of light vehicle sales through 2016, then its decline through 2022, and rebounding upward through 2027—this pattern is perhaps illustrative of the increased presence of Millennials in the labor force with their initially anti-automobile bias, then as some age they change preferences, and then the increased importance of ethnic preferences begins taking over in consumer trends.

What does all this mean for plastics as a material of choice in the automotive and transportation market? Here too most drivers and key trends seem to favor, if anything, an increased usage of plastics. Lightweighting is an imperative as more and more metal parts of automo-

biles are being replaced with plastics even in the engines themselves, and certainly the rise of 3D printing and its derivatives only paves the way for more innovative applications of plastics. Even with some reduction in automobiles produced, many other current transportation modes utilize large amounts of plastics, aviation for example. Given the inherent advantages that plastics represent compared to other alternative materials, it is extremely likely that the transportation choices of the future will use more, not less.

Supply Chain Implications

While each company will need to look at its particular circumstances to develop its own unique business strategy for the years ahead, using information in this report as a guide, we offer the following as starting points for various parts of the supply chain.

Equipment Manufacturers

If generational trends are accurately saying that Millennials don't care intensely about brand loyalty or car ownership, this could lead to fewer vehicle types being produced, which for equipment manufacturers, could mean fewer toolings, bigger parts needing different machines and similar adjustments. However, Michael Robinet, Managing Director of IHS Automotive, reports that this transition is not yet on the horizon. In fact, automakers are planning a "sobering" number of product launches—161—worldwide in 2018; the result of a proliferation of global platforms, competitive pressures on their products and rising fuel economy requirements. The "heavy lifting" for those new vehicles is being done now, Robinet said, and the efficiency demands being made on those designs are larger than at any time in the past.

OEMs are increasing the number of models they offer while reducing the number of vehicle architectures on which

they are built, dramatically improving product commonality. Volkswagen, the first major OEM to embrace this strategy, is moving toward four modular platforms. GM is going from 30 core and regional platforms in 2010 to 26 in 2015, and has announced its intention to go with only four flexible platforms by 2025. Toyota, Ford, and other OEMs are following suit. The resulting variation increases costs marginally, but the additional expense is offset by savings from the sharing of common components between cars and platforms, and increased volume.¹⁶

So the next-generation model being pursued by OEMs is ultimately being shaped by calculations other than simply more Millennials buying fewer automobiles. In part, this strategy clearly takes into account developments identified in this study, i.e., some Millennials' values and preferences will change over time, the purchasing choices of new immigrants and their desire to participate in the American dream, and increased global market opportunities facilitated by free trade agreements.

For processors and moldmakers who supply the automobile sector, this would suggest an initial upsurge in demand as the OEMs each transition to their new platforms. After the initial transition is complete, demand will level off in part perhaps, but if the tempo of new vehicle launches continues, and there is good evidence to suggest it will, then demand will increase annually fueled by the new components differentiating the new vehicles.

Also important for OEMs and the plastics industry is that the car of the future will be connected—monitoring, in real time, its own working parts and road conditions around it but also communicating with other vehicles and with an increasingly intelligent roadway infrastructure. These features will be must-haves for all cars, which will become less like metal boxes and more like integrators of multiple technologies, productive data centers—and, ultimately, components of a larger mobility network.

Today's average high-end car has roughly seven times more programming code than a Boeing 787. The cost of electronics and software content in autos was less than



20 percent of the total cost a decade ago. Today it is as much as 35 percent, according to studies by Manfred Broy, a Professor of Informatics at Technical University, Munich. More importantly, electronics systems continue to contribute more than 90 percent of innovations and new features. All major OEMs are targeting traditional product areas such as quality and safety; "infotainment" provides a way for OEMs and suppliers to differentiate their products. A recent Consumer Reports survey found that infotainment

¹⁶ PwC 2015.

equipment was the most troublesome feature in 2014 vehicles, suggesting a powerful upside for companies that can devise superior systems.¹⁷

This increased digitalization of automobiles presents significant added opportunities for more plastics in vehicles as the material of choice when it comes to the unique electrostatic, conductivity properties, etc. of plastics. Now plastics have the chance to meet the transportation requirements as well as the computing and consumer electronics needs of future automobiles. Increased circuitry integrated in new ways into vehicles also suggests the need for new automation applications in the manufacturing process.

Resin Suppliers

Continuing demand for lightweighting, which is expected to become even more intense in the years ahead, will intensify pressure to develop more innovative lightweight materials and bring them online. Robinet notes that efforts to improve fuel economy have so far focused on powertrain and aerodynamic gains, “but the heavy lifting is going to have to come from lightweighting.” If public policy drivers, i.e., CAFE, mean greater material demands, material suppliers will need to provide continual improvements in materials for more structural, high demand parts.

An important element for resin suppliers will be early engagement with the automotive industry in the design process. This will allow consideration of new designs that maximize performance, cost and manufacturability, looking at a variety of materials applicable to the design. Having an earlier view of a project during the design phase can allow for input from the materials side that can lead to further advances. Use of plastics in lightweighting vehicles has proven to be a cost-effective way to help boost vehicle mileage for decades. And that approach is not going to change.

Robinet said if a manufacturer plans to keep a vehicle in production for four years, the initial design must achieve a 20 percent gain in fuel economy over what it replaces just to keep up with the 5 percent annual fuel economy gains demanded of automakers. “You can’t just sit on a vehicle for eight or nine years and think that people are going to continue to buy it,” he said.

Tiers 1 and 2

With 135 or more new vehicle launches a year taking place, compared to 85 a year in 2010 and 2011, there is tremendous pressure on a supply base that is already strained to keep up, said Robinet. “If suppliers can’t handle the pace, launches could start slipping.”

The larger Tier 1 suppliers are rising to the challenge, but many of the smaller Tier 1 and 2 companies are fearful of another collapse of the automobile market so fresh in memory. The OEMs are looking for assurance that their suppliers can keep pace with the launches. Also, according to IHS Supplier Business, smaller suppliers are “finding business increasingly difficult as a small group of huge suppliers look to take bigger contracts from the OEMs—and conditions are only going to get tougher.”

One capability in suppliers of rising concern to OEMs’ is more R&D. “When it comes to R&D, big suppliers can dwarf the investment from the smaller competitors, providing them with a major advantage,” IHS said. “As automakers implement (global

platforms for light-vehicle production), they are relying on suppliers to make the necessary investment in the research and development of new technologies and also their international facilities.”

For example, International Automotive Components (IAC) Group, a large global Tier 1 supplier with more than 90 manufacturing locations, has developed new plastics processing technologies for producing better, more aesthetic vehicle interiors. IAC provide a range of instrument panel solutions including air distribution ducts, air outlets, glove boxes, decorative appliques and other trim. The company has developed “unique surface materials” that it says “offer superior surface workmanship in touch, color, train and gloss.”

3D Printing

Without a doubt, 3D printing will transform manufacturing as we know it. As a result, each manufacturer must examine its significance for them and incorporate it into their respective strategic plans. In looking specifically at automobile manufacturing and the plastics industry, two considerations immediately present themselves. First, materials can now be woven together whereas previously parts might have been over molded or welded. Old materials combined in new ways offering new applications. Second, approaches to inventory holding and just-in-time delivery are radically altered too. When you think how this technology could completely change the entire automobile buying experience, you see how a more collaborative and cooperative relationship might evolve between the material supplier, the processor and the OEM in the not too distant future.

¹⁷ PwC 2015.

More information:
www.plasticsmarketwatch.org





SPI: The Plastics Industry Trade Association
1425 K Street NW., Suite 500
Washington, DC 20005
202.974.5200
fax 202.296.7005
plasticsindustry.org

