The health of the die casting industry in the United States depends on the growth of the economy. The industry is a three to six month leading economic indicator and has started the fourth quarter of 2015 with moderating orders, except in the automotive industry.

The GDP growth in 2015, and most years since the 2009 recession, has been positive but has not gained as much as previous years that were between economic downturns.

Consumers previously reacted to unemployment numbers. If the unemployment percentage was high, the confidence in the economy was low. When unemployment percentages were low, consumers were very positive. They have learned over the years that the percentage of unemployed is a meaningless number. What is more important is the total number of unemployed between the ages of 16 and 65.

The number of unemployed 27 weeks and over is at its highest level ever. Almost 24% of the people between 16 and 65 are not working! Were the labor force participation rate the same today as when Obama took office, unemployment would be about 10 percent.

Beyond this year, long-term labor force participation is forecast to decline all the way through 2025.

When the number of unemployed is added to the number of under-employed, the growth of the economy suffers. Under-employed results in lower labor rates and causes personal consumption to stay low.
Personal consumption has declined since mid-2014 and the overall expenditures since the 2009 recession have not reached the high levels seen from the early 1990’s to now. The United States has the largest economy in the world. It is almost three times larger than the number two economy of China. Within our economy, two-thirds of it is made up of consumer spending. Without consumer spending, the economy is forecast stay at its slow 2.2 to 2.5 percent GDP growth through 2017.

What’s in Our Way?

### Government
- Election
- EPA
- Ozone
- GHG
- Water
- OSHA
- Temporary Workers
- Reporting Frequency
- Plant Condition - Accidents

### External Factors
- Terrorism
- Weather

### Internal Factors
- Lack of Technology Adaptation
- Lack of Training
- Lack of Planning for Future
- Talent
- Lack of Investment

There are many factors in the way of growing the number of employed. These include government intrusions/burdens, external factors and internal business factors. The United States government appears dysfunctional at best. Impending or proposed EPA and OSHA rules/regulations add to the cost of doing business and never adds as much value to the economy. (You can read more about the impact OSHA and EPA have specifically on die casting on our website at [http://www.diecasting.org/wcm/Government_Affairs/GA_Update/wcm/Govt_Affairs/GA_Update.aspx](http://www.diecasting.org/wcm/Government_Affairs/GA_Update/wcm/Govt_Affairs/GA_Update.aspx))

Add the complicated and outdated business tax structure and the vacillating Federal Reserve policies and manufacturing businesses seek solutions in other countries rather than fight these burdens.

The economy can also be impacted by external factors like bad weather and terrorism. Both of these create only a temporary setback to the direction of the economy and future quarter’s growth make up for the losses.

The biggest influence a die caster can have on the health of his business lies in how they address the internal factors. Lack of technology adaptation leads the way. Closely followed by not planning for their future talent and then not investing in the business.

Two separate surveys, of the same die casters, in the first quarter of 2015 and the 3rd quarter of 2015 showed a higher optimism in the later survey for business in 2016.

The optimism is fueled by the strong growth in aluminum auto and light truck casting production. This end market for aluminum castings has grown steadily each quarter since the 2009 recession. Interestingly, the wheel market and “all other industries” have stayed about the same since then.
The growth in foundry aluminum shipments has been more prevalent in the die casting area than the sand or permanent mold casting areas. In my opinion, this is predominantly due to the die casting industry’s ability to produce higher strength castings with new alloy systems and modifications to their existing alloys.

The geographic location of this growth is shifting as well. The percentage of die casting machines in the Midwest has gone from 47% in 2006 to 38% in 2014, while the change is the opposite in the Southeast part of the country. This has grown from 13% in 2006 to 25% in 2014.

The aluminum machine size distribution reflects this growth as well. Larger machines for larger die castings.

The die casting industry is changing, not only in its geographic location and machine sizes, but in its productivity. Productivity has grown by 40% since 2000 and the trend will continue. Die casters that do not apply the new alloys or technologies to become more productive will not grow as rapidly as those that do.

NADCA is developing a way for die casters to benchmark their operations key indices against other die casters with similar market focus. Comparing the key business indicators of a large auto die caster to a small non-automotive die caster is like comparing apples and oranges. NADCA’s approach is to allow searching within groups. Search criteria includes the type of metal, machine sizes, end markets served (auto versus non-auto), total part numbers and scrap factors.
The searches result in data that is more relevant to the type of die caster group. The search shows dollars/machine, employees/machine, and other important relational data. The die caster can see where they fall, within their defined group. This will tell them if they are ‘best in class’ or not.

The benchmarking exercise will also help delineate the best in class for profitability. The current data is a collection of the entire industry and shows a consistent profit margin of around 4.5%. It is hoped that by segmenting the overall into ‘like’ groups, a different picture will emerge.

Over 30% of the cost to produce a die casting is in material costs. It is important to understand the outlook for prices in aluminum and zinc. The following is an excerpt from a report by Wood-McKenzie.

“The aluminum market continues to look extremely weak, which is not a surprise given persistent oversupply and high stocks. We expect this to keep prices under pressure. Down at these price levels, however, we might expect a greater supply response before too long. Although this should primarily be seen in China, local vested interests are likely to prevent it, so we expect the important cuts will have to come from outside China. In the absence of this, aluminum prices are likely to bounce along the bottom for a long time until there is a strong rebound in demand. That bottom may be getting progressively lower as production costs slide amid cheaper inputs. At the moment we would look for range-trading opportunities, buying on any cutback announcements and selling into rallies above $1,600/tonne.’’

“Zinc is consolidating as we wait to see if Glencore’s cutbacks have been enough to turn sentiment bullish again. Over the past two years there have been two major false starts to the zinc bull story in which price rallies have failed and collapsed. Ironically, now that the well telegraphed mine closures are upon us and Glencore has cut back too, prices are struggling to rally. Before funds turn bullish again, more evidence is needed that the market is entering a period of genuine supply deficit. This might provide a window of opportunity to consumers who are in a position to do strategic forward buying. Once funds do get bullish, another strong rally is likely amid anticipation of the deficits eroding the stock overhang.”

Energy accounts for 6-8% of the overall costs in a die casting operation.

Natural gas prices are expected to remain low for the rest of 2015 and all of 2016. Shale gas production continues to grow and keep a downward pressure on the price. The EIA projects, under any scenario, that natural gas prices will not rise much throughout 2016.

Electricity also is forecast to stay the same or even slightly lower with stable natural gas prices.
The largest market served by the die casting industry is automotive. Automotive sales and production are still very strong and projected to stay strong in 2016. In October, 2015, the SAAR topped 18 million for the second consecutive month. “U.S. automakers delivered 1.45 million light vehicles in October, driving the seasonally adjusted annual rate past 18 million units for the second straight month. The 2-month streak is the industry’s best since June-July 2005.”(Wards) For the year, sales are expected to exceed the originally forecast of 17.5M up to 17.8M.

The new home market continues to rise, but is still not moving at a pace that will significantly impact the die casting orders. The problem in the housing market is the number of houses ‘underwater’. There are over 11M homes that owe more on their mortgage than they are worth. Families with homes underwater have the money to buy a home, but cannot afford to take a loss on their current home.

Growth in 2016 will be tempered by the Fed Reserves decision to raise the benchmark interest rate. Higher mortgage interest rates will slow the new home market.

Medium and Heavy duty trucks will be required to reduce their greenhouse gas emissions even further. A new regulation goes into effect in June 2016. Truck producers will see a growth in sales and die castings will benefit from the newer designs requiring lighter weight materials in order to hit the higher gas mileage requirements.

Appliance production has remained relatively stable since 2012. With 2015 being a down year, it is expected that 2016 will grow by 4% over 2015.
Overall, non-transportation consumer goods percentage change year over year went negative in 2015. This means that overall, 2015 was worse than 2014 in non-automotive consumer goods. This is also shown in the quarterly foundry shipment graph for ‘all other industries’.

With lower projected personal expenditures and growing durable goods inventories, it may be that the economy in the first quarter of 2016 may not produce the 2.3% GDP growth forecast. If the die casting industry is a leading economic indicator, I believe there could be slower than forecast economic conditions which would result in a slow 1st quarter. Beyond the first quarter, the economy could rebound back to the forecast levels, but if interest rates rise, there could be a further drag on the potential growth.

Besides the traditional end markets for die castings, there is potential to expand the applications into other markets. With this in mind, NADCA commissioned a study by Bill Downey to investigate the potential for die castings in non-automotive markets. Downey’s study was based on the requests for information that NADCA receives from OEM’s over a three year period. Downey evaluated these requests and the companies they were from. He then surveyed the end markets of those companies to determine their understanding and interest in die casting. The study showed that there were many markets that die castings are finding a growing interest in and those markets need more knowledge of our technology. Downey’s report can be found at www.diecasting.org/docs/dce/downey2015.pdf.
Despite some indicators of slow economic growth the die casting industry is expected to be slightly better in sales than 2015. Most of the growth will be from automotive increased applications in the automotive industry and increases in production to meet the sales demand.

Worldwide, automobile production is expected to grow by 40% between 2007 and 2016. By 2025, all estimates are that worldwide auto production will exceed 112M annually.

Current markets will remain somewhat strong and emerging markets will grow in China and elsewhere. This growth forecast shows only the beginning of the curve for India. They lag about 10 years behind and their rapid expansion will be seen between 2020 and 2030!

The applications of die castings in the automotive industry will grow by 50% by 2025.

North America will maintain a 20% share of the global market.

Aluminum use on the automobile is expected to continue its growth in 2016. This may exceed 400#/car. In 2025 this is expected to be 547 pounds per car on the average.

If you couple the growth in usage with the projected growth in the number of vehicles worldwide, die castings will continue to be a major part in every vehicle.
The aluminum product mix will go from 81% castings and 19% mill products in 2012 to 61% castings and 39% mill products in 2025.

![Figure 30](image)

**Figure 30** - When we look at HPDC in general, here is what the growth looks like.

When we look at the change in product mix there is a decrease in the percentage of castings on the vehicle. This is mostly due to the growth in the flat roll of aluminum body enclosures. We think there’s opportunity not only in the growth of aluminum high-pressure die casting but also that aluminum die casting will impact at a higher percentage the flat rolled market and permanent mold market. Thus exceeding the projected 146 pounds on average per vehicle in 2025.

When we look at HPDC in general, here is what the growth looks like.

![Figure 31](image)

**Figure 31** - Stay viable or vanish.

In the material world when it comes to castings your metal and process need to stay viable or vanish. Iron castings have declined over the years between 1995 in 2013. Similarly, zinc die castings were used in the late 50s and early 60s and almost none are used on an automobile today.

![Figure 32](image)

**Figure 32** - Process technology has been much greater for HPDC because there is more potential for advancement.

![Figure 33](image)

**Figure 33** - Predicted life of engine bed plate in XK360 at 1.06% and .46% Fe content.

I believe the key reason for this change is due to the advancements in die casting properties with alloy chemistry changes. In this design, the predicted life of the engine bed plate goes from 900 hours at one joint to 76,000 hours. This was done by just lowering the iron content from 1.06% to .46% and adding Sr.

![Figure 34](image)

**Figure 34** - Tensile mechanical properties - Summary of Low Fe die casting alloys.

<table>
<thead>
<tr>
<th></th>
<th>UTS (Mpa)</th>
<th>YS (Mpa)</th>
<th>%Elong.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A380 std</td>
<td>324</td>
<td>158</td>
<td>3.5</td>
</tr>
<tr>
<td>F380</td>
<td>318</td>
<td>161</td>
<td>5</td>
</tr>
<tr>
<td>E380-T6*</td>
<td>421</td>
<td>338</td>
<td>2.9</td>
</tr>
<tr>
<td>A360</td>
<td>317</td>
<td>165</td>
<td>3.5</td>
</tr>
<tr>
<td>B360</td>
<td>321</td>
<td>162</td>
<td>6.1</td>
</tr>
<tr>
<td>B360-T5</td>
<td>359</td>
<td>256</td>
<td>3.6</td>
</tr>
<tr>
<td>A360-T6</td>
<td>365</td>
<td>283</td>
<td>5.8</td>
</tr>
<tr>
<td>383</td>
<td>310</td>
<td>152</td>
<td>3.5</td>
</tr>
<tr>
<td>C383*</td>
<td>316</td>
<td>163</td>
<td>4.5</td>
</tr>
</tbody>
</table>

*0.36 Mg

For alloys 380, 383, 384, 360 [and any of their variants, like A380 or E380], which have an unspecified “other each”, you can lower the Fe to 0.40% and add 0.05-0.07%Sr --- and you will not have to change the AI Association specification for your alloy --- and this will double the ductility and increase the UTS by 10% for the die castings you are making.
The discovery that strontium provides die soldering resistance, and this is supported by 250 million lbs of metal having been treated with Sr over the last ten years.

This is a technology adaptation that the automotive die casters have embraced and must be implemented in all die casting. The rapid change in the generations of the alloys have been remarkable.

1. First generation die cast alloys, relied on iron to avoid die soldering, but iron severely degraded mechanical properties and were “not for structural parts”.

2. Second generation alloys [Silafor-36 & Aural-2], relied “only on high manganese” at 0.5-0.8% levels to avoid die soldering, but were low in Fe, with other elements <0.03%.

3. Third generation alloys are low Fe alloys, that rely “on low Mn [0.25-0.35%] & Sr [0.05-0.07%]” to avoid die soldering, & are very good in high strain rate applications.

4. Fourth generation alloys are alloys that also rely “on low Mn [0.25-0.35%] and Sr [0.05-0.07%]” to avoid die soldering but also contain high levels of Cu for die cast fluidity & avoid the Al5SiFe phase because Fe<0.40%.

Structural die castings have significantly grown the automotive market and they are entering other end markets. Die casters need to learn how to melt and pour these type of alloys and look to apply their superior mechanical properties to other end market components.

**Summary**

The economy will not grow more than 2.5% in the next several years. Labor Force Participation will continue to decline due to retirement age and meaningful employment opportunities. Wage rates will not increase and as a result personal consumption will not grow. Consumers will have less of an impact on the economy because healthcare and entitlements will take on a larger part of the GDP.

The government creates roadblocks to success in many ways. Rising interest rates will impact home sales, EPA regulations will hamper business growth and opportunity to expand in the U.S.

However, the biggest threats to die casting are internal factors such as technology adaptation, workforce realignment and building a farm system.

Forecasts show that 2016 will start out slow for die casters. The whole year will see a 5% growth. Automotive castings will be the main driver to improved shipment performance. Industry profits are still low. Energy and alloy prices will remain low. There will be a growth in die casting over other casting processes. The housing industry will be impacted negatively by rising interest rates. Heavy trucks have some market potential due to the requirements to lower emissions. Appliances and other durable goods are projected to be about the same as 2015. New markets could be developed in robotics, aerospace, alternative energy, and medical.

Technology adaptation is imperative in the die casting industry. The automotive industry is driving alloy changes to low iron alloys with crash worthy properties. Along with alloy changes, new process technologies could dramatically alter the die casting industry in a positive way for the early adapters. These include: conformal cooling of dies and cores; semi-permanent die coatings; higher energy efficiency process; thinner walled creates new markets; molten metal on demand for higher efficiencies and changing alloys more easily.

If you are a forward thinker in the industry, the next five to ten years will be exciting and markets will open up for your company. If you want to move forward with your old alloys and existing process technologies, you may find yourself in the Smithsonian next to the 1907 Doehler die casting machine.