

# Gear Material Risks and Rewards

TECHNOLOGY INVESTMENTS  
LEAD TO PRODUCT INNOVATION

Matthew Jaster, Associate Editor

The business of raw materials has been rather turbulent of late, with a hodgepodge of press releases calling for equal amounts of optimism and pessimism. One minute the market looks flat, the next minute signs point to a quick recovery. Either way, the gear industry wouldn't get very far without the steel, plastic, powder metal, etc. needed to make the various products. Ignoring mass media hysteria, raw materials seem to have the same problems as other industrial markets: prices are high, the environmental impact needs to be addressed and recovery from economic instability has taken a toll. Toss in an earthquake in Japan, erroneous trade regulations and national debt issues and you've got all sorts of melodrama heading into the fall of 2011.

"The continuing increase in raw material costs along with process fluids and gases remain a challenge for our industry," says Richard Slattery, vice president of engineering at Capstan Atlantic, a global manufacturer of sintered metal products. "This is not industry-specific, as all manufacturing sectors have to deal with this."

"Governments and industry will  
**continued**



DuPont supplies Delrin POM material for planetary transmission gears (courtesy of DuPont).

have to explore policy means to ensure secure, predictable and accessible supply of steel raw materials for all steel producers,” says Risaburo Nezu, chairman of the Organization for Economic Cooperation and Development (OECD) Steel Committee. “Global risk factors include concerns regarding financial systems of many economies, remaining sovereign risks due to high levels of public debt, sluggish growth in advanced economies and high oil prices linked to geopolitical risks in the Middle East.”

And yet there’s hope for bigger and better things in the months ahead. DuPont, for example, is adamantly seeking biomass processing and microbial engineering that will create new bio-fuels and bio-based materials. The sintered metal industry is scratching and clawing its way back from an economic recession that eliminated many jobs, but also created a huge increase in customer demand once the smoke cleared. The steel industry in Japan, the world’s biggest steel importer, is finally returning to levels seen before

the earthquake and tsunami. This is good news considering initial fears that a supply crunch would negatively impact the Japanese economy for years to come.

Various reports—from *Bloomberg News* to *Industry Week*—state that growing demand for raw materials here and abroad will lead to bigger long-term dividends thanks to new technology, environmental policies and product innovation. Here’s a sample of the some of the latest news coming from plastic, steel and powder metal companies:

#### **DuPont Focuses on Renewable Raw Materials**

DuPont Chair and CEO Ellen Kullman recently told investors at the JPMorgan Diversified Industries Conference to expect attractive long-term growth from DuPont through product and process innovation, selective investment in attractive areas, broad-based growth, especially in developing markets and a relentless focus on productivity.

“We believe DuPont is uniquely

positioned to tackle big global challenges that offer the opportunity for significant top-line growth and value creation,” said Kullman. “The recent acquisition of Danisco, (a leader in food ingredients, enzymes and bio-based solutions) is a perfect fit with our growth strategy around feeding a growing population, decreasing dependence on fossil fuels and protecting people and the environment.”

“We will leverage Danisco’s world-leading capabilities in enzymes and fermentation, with DuPont’s strengths in biomass processing and microbial engineering. This combination results in a powerful, integrated set of tools to create the next generation of cost-effective biofuels and biobased materials,” said Kullman. “Simply put, our vision is to start with renewable raw materials and create differentiated products with excellent environmental profiles and superior economics for our customers.”

Kullman indicated that DuPont continues to focus on market-driven

**continued**



The steel production peak in 2007 was surpassed in 2010 by 15 percent (courtesy of Jaycy Castandeda).

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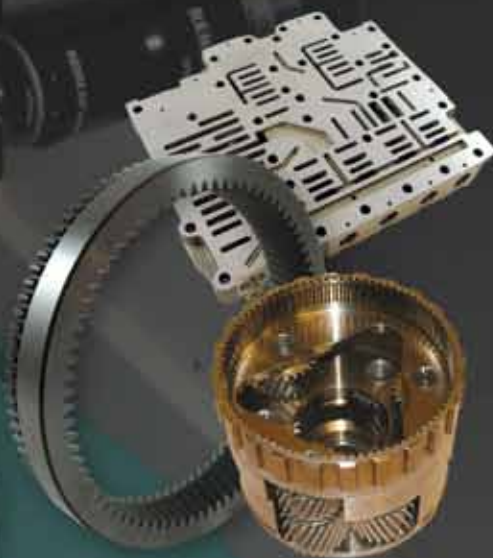
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**Ellen Kullman, DuPont  
Chairman and CEO.**

science to meet market needs. In 2010, 31 percent of the company's sales came from products that were introduced within the past four years, "We

have made innovation and productivity a part of our DNA at DuPont," Kullman said. "We are currently in the midst of a \$1 billion initiative both in fixed cost productivity and working capital productivity. We are well on our way to delivering our 2011 targets of \$300 million for each."

"Our businesses are delivering strong results, building on the momentum from 2010 and first quarter 2011," said Kullman. "We expect our resource

investments, coupled with innovative product offerings and market demands aligned with the megatrends, will enrich the company's mix of high-growth, high-value offerings. Based on current expectations for long-term sales growth, the high-growth business segments will shift from 48 percent of the portfolio in 2010 to 57 percent by 2015."

In addition, the company recently announced plans to open new global innovation centers, with the first in Asia Pacific. The two innovation centers opening this month include one in Korea, servicing the electronics and automotive industries, and another in Taiwan, focusing on the electronics and communications markets.

Beginning in the fall, new innovation centers in Thailand and India also will be ready to collaborate with customers around renewable energy initiatives and innovations. Additional centers are planned in Latin America, Europe and North America. DuPont's

goal is to partner on solutions that fuel local collaboration and application development and engage customers in inclusive innovation—wherever they are in the world.

"The global population has grown to seven billion, generating great need for food, energy and protection. We realize that meeting these needs will require more than science, said Thomas M. Connelly, executive vice president and chief innovation officer. "Globally, we are committed to leading collaborative and inclusive innovations to respond to the challenges facing the world today. Collaboration is the driving force behind establishing these country-focused innovation centers."

**For more information:**

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## OECD Examines

### Long-Term Steel Strategies

According to the World Steel Association (WSA), the overall demand of global steel increased by 13.2 percent in 2010 thanks to increased production activity in the industrial sector. The demand in China and other emerging economies has strengthened, surpassing the numbers found before the recent economic crisis. In fact, the production peak in 2007 was surpassed in 2010 by 15 percent. The WSA reports that approximately half of the world's steel output growth occurred in Asia.

The steel market forecast in 2011–2012 is moderately good, according to the WSA. A slowdown in steel production in the second half of 2010 was countered in the first quarter of 2011 where production, led by China, has accelerated 10 percent. Global demand for steel is set to increase this year and next thanks to emerging markets like India and China, according to the

OECD Steel Committee.

The OECD believes a discussion is necessary to explore and encourage policies like increasing resource efficiency, promoting recycling and facilitating the use of secondary raw materials. High prices and restrictive trade policy measures are equally a major cause of concern for many involved in the OECD Steel Committee.

Since global production of some raw materials is highly concentrated, there are risks of potential supply disturbances. Additionally, export restrictions and other regulations are increasingly applied in some producer countries, including export bans and licensing requirements, to support downstream production of higher value-added activity such as steel.

Another key issue involves the environmental impact. The iron and steel industry—both major contributors to CO2 emissions—are expected to play a large role in mitigating climate change. This is a double-edged sword

as economic development during the 21st century will require ever growing amounts of steel. The Steel Committee reports that governments and industry must prepare for the large, rapid and risky uptake of new technologies when they become commercially available in 10–20 years.

“Policy makers must explore the policies needed to encourage this long-term transition while simultaneously creating a level playing field among producing economies that allows the industry to compete on the basis of fundamental market-driven economic factors,” Nezu said in a recent statement on the steel industry. “Global steel trade continued to recover in 2010 with exports worldwide reaching 378 million tons—up by 18 percent compared to 2009. This trend is expected to continue.”

Some trade and trade-related measures have nevertheless been applied to steel such as import taxes, import

**continued**

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valuation procedures, differential VAT rebates, and import licensing systems, in addition to the use of trade remedies, according to Nezu.

“While the use of trade remedies has not reached the levels seen in previous market downturns, there are still concerns about unfair trade. However, the product composition of trade appears to be changing, as steel makers in some economies move rapidly up the steel value chain, creating challenges for steel producers in other economies.”

The global steel industry has shown resilience to sustain investment in recent years. Sizable investments are made, particularly in emerging economies, not only to modernize existing plants in order to lower energy consumption and produce higher-quality steels, but also to build significant new capacities.

In addition, there are heavy investments to integrate backwards particularly into iron ore, to benefit from the wide gap between the iron ore price and the

cost of producing this key raw material.

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**Powder Metal Gears Poised for Significant Growth**

With approximately 60 percent of its business in the auto industry—75 percent industry-wide—Capstan Atlantic has seen a significant increase in PM consumption over the last 12 months. “Capstan is now enjoying record sales levels, in part due to an uptick in automotive volume,” Slattery says. “Focus growth areas are: suspension, powertrain, steering column and EPS (electronic power steering) assist. Powder metallurgy, with its continued focus on high dense, high performance material/process systems coupled with improved dimensional precision, is poised for significant growth within the gear industry.”

As mentioned earlier, Capstan Atlantic and the PM industry as a whole took an enormous hit during the economic recession. “The challenge was in re-staffing when business came back,” Slattery says. “It ramped up so quickly, we struggled to get trained manpower in place to meet what in some cases was a 400 percent increase in customer demands.”

Thankfully, the company-wide strategies put in place during the downturn helped in preparing for the business

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Capstan Atlantic is adapting its net shape gear tooth precision technologies to new non-gear applications (courtesy of Capstan).



**Capstan has enjoyed new business opportunities with its high-dense crowned gear technology (courtesy of Capstan).**

boom that soon followed. “We became a leaner organization as a result of the economic downturn, and are a much healthier company today because of it,” Slattery says. “We continue to develop and train our talent internally. We find that if we can find people with a good attitude that are willing and capable of learning, we can train them to be talented PM professionals. Robust training systems are keys to survival when dealing with employee turnover due to retirement, etc.”

The biggest challenge facing powder metal manufacturers is the same issue found in both steel and plastic. Customers are having a difficult time accepting price increases. “Discussions surrounding price increases can sometimes put strain on a relationship with a customer. In the end, the objective is to develop a solution that everyone can live with,” Slattery says.

On the product side, Capstan Atlantic continues to enjoy new business opportunities with the marketing and sale of its high-dense crowned gear technology. Crowned gears significantly improve load distribution on gear teeth by eliminating the potential of “point loading,” while also providing noise reduction.

Gear crowning is a secondary operation performed on an as-sintered preform, and something not previously

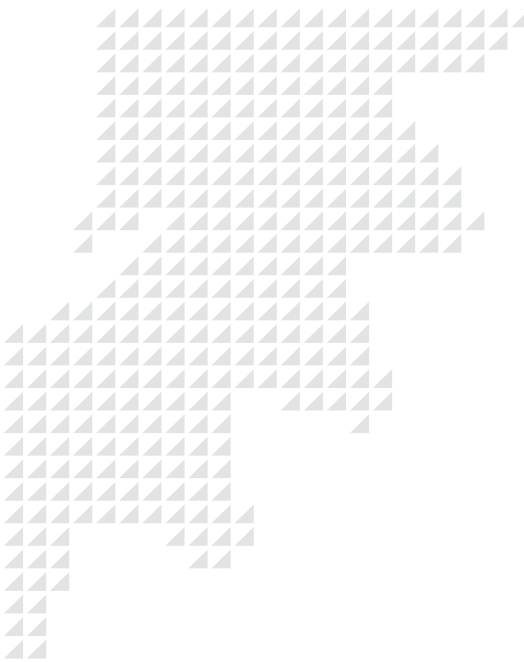
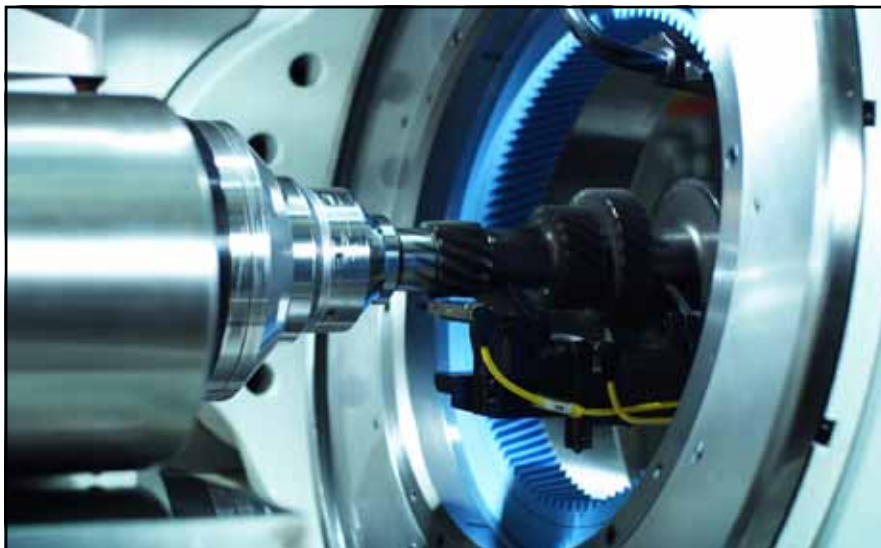
available to the marketplace in a PM gear. Field tests on single pressed, high dense, crowned, carburized gears have shown a 100 percent increase in contact fatigue endurance, over conventionally supplied heat treated PM gears. This is due to the influence of the crown on contact stress distribution.

The continuing marketing efforts associated with this technology enable penetration of markets not previously considered for powder metallurgy. Further development continues on sta-

bilizing component distortion through heat treatment to provide more precise gears to the marketplace. Current process capability yields gears at AGMA Q8/9 precision levels.

Capstan Atlantic is also adapting its net shape gear tooth precision technologies to new non-gear applications. “There are many toothed, non-involute gear shapes in the marketplace requiring the same level of precision as the gears we currently manufacture,”

**continued**



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**Capstan has developed non-involute  
profile measurement methods to moni-  
tor characteristics.**

Slattery adds. Capstan is now pursu-  
ing these applications and realizing the  
benefits of the varied markets.

These tooth shapes can be defined  
by a series of compound radii at X,  
Y coordinates—or intersecting lines,  
angles and radii. Precision control of  
these tooth profiles is critical for fea-  
tures such as strength and noise reduc-  
tion. Conventional approaches to these  
technologies have included post-sinter  
calibration methods such as sizing or  
machining. Through precise tool con-  
trol, along with minimal sectional den-  
sity variation and cleverly employed  
sinter distortion control methods,  
Capstan Atlantic is meeting profile tol-  
erances within 25 microns, net shape.

Additionally Capstan has devel-  
oped variable non-involute profile  
measurement methods to develop, con-  
trol and monitor these characteristics.  
Further work in this area is focused  
on cam surface geometries, coupled  
with single pressed high dense meth-  
ods, targeting aggressive rolling con-  
tact fatigue applications. ⚙️

### For more information:

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