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Some Factual Perspectives on the Future, Viability of the U.S. Coal Industry

By Steven J. Storts
Dublin, Ohio

ONE of the more contentious, and yet inviting, issues of the 2016 political campaign last fall was the impending revitalization (or demise) of the U.S. coal mining industry, particularly that of the Appalachian region in states such as Kentucky, Pennsylvania, and West Virginia. The political rhetoric was quite polarizing. On one end of the campaign spectrum was Donald Trump's vow to bring back coal mining jobs and expand current domestic energy development; on the other end, Hillary Clinton was on record for wanting to end coal mining and replace it with workforce retraining, favoring cleaner energy alternatives and extending the Obama administration's directives in curbing electricity generation via coal-fired power plants.

The U.S. Energy Information Administration estimates that coal production declined 18 percent in 2016, the lowest level of coal produced since 1978. EIA's forecast this year, however, calls for modest growth in coal-fired electricity generation, which is expected to lead to a seven percent increase in U.S. coal production.

Actually, the forecast may be better than projected. As of mid-January, EIA's reported production estimate was 14.1 percent higher than the first week of 2017, and 13.4 percent higher than the production estimate in the comparable week of last year. Another hopeful sign is that year-to-date coal production is 9.2 percent higher than the comparable year-to-date production figure in 2016.

On a related front, coal consumption in the electric power industry, which accounts for more than 90 percent of the total U.S. coal market, is estimated by EIA to have declined by eight percent last year, mostly attributed to competition with low-priced natural gas, the fracking boom, and reduced overall electricity demand due to relatively mild weather conditions.

Other commonly cited reasons for the downturn include declining international coal demand, legal challenges from environmental advocacy groups, and sweeping environmental regulations under the Obama administration making it more difficult for utilities to justify further capital expenditures in coal-fired plants.

However, because of recent rising natural gas prices and increasing electricity generation, coal consumption in the power sector is forecasted to increase by six percent in 2017. A reverse of this trend, though, is expected in 2018, leading to a small one percent decline in coal consumption by the power industry. EIA also estimates that the delivered coal price last year averaged four percent lower than in 2015, but that coal prices are projected to modestly increase both this year and in 2018.

Of course, it should be pointed out that any significant resurgence of the coal mining industry will tend to more heavily favor the Western and Interior coal regions first, followed by the Appalachian states, based on current coal production and consumption figures. Total coal production in 2018 is expected to increase only slightly, according to EIA projections, with the Western region showing the most gain, offset by small declines in the Interior and Appalachian regions.

Still, any improvement in coal mining nationwide would have a residual positive effect on the Appalachian region, albeit to a lesser degree. Western coal is generally lower in sulfur content and otherwise cleaner-burning than coal from Appalachian mines, making it a desirable choice for power companies operating under stringent Clean Air Act regulations.

Five states account for about 70 percent of total U.S. coal production: Wyoming, West Virginia, Kentucky, Pennsylvania, and Illinois. The North Antelope Rochelle and Black Thunder mines in Wyoming each yield about as much coal as West Virginia, the second-largest coal-producing state. In 2014, Wyoming produced 73 percent of the coal mined in the Western coal region. In fact, eight of the top 10 producing coal mines in the United States are located in Wyoming. Illinois, the largest coal producer in the Interior coal region, accounts for more than 30 percent of the region's coal production and six percent of total U.S. coal production. Underground mines supply the majority (more than 70 percent) of the coal produced in the Appalachian region, whereas surface mining produces about 90 percent of the coal in the Western region and is considered more efficient.

The Daily Caller news service reports that market changes are contributing to the recent rise in coal prices, with global coal prices more than doubling over the past 12 months. For instance, the price of coal in Australia and China has soared by 150 percent from November 2015 to November of last year, according to Bloomberg news sources.

The Caller's energy and science reporter, Andrew Follett, contends that

such massive price fluctuations are due to regulatory changes in the Chinese steel industry and increased demand in India, which caused coal prices to rise by 20 percent in a single week last September. He notes that rapidly rising coal prices have prompted companies to invest $90 million into a pair of new coal mines in Virginia and West Virginia, creating about 400 jobs in counties where unemployment is almost three times the national average.

From a different perspective, Jason Hayes, associate director of the American Coal Council, says "the industry's downturn is bigger and more unusual than previous ones," but he expects coal to make a comeback as prices for natural gas inevitably start to rise, according to a *Casa Grande Dispatch* article "Coal Expected to Make a Comeback." As reprinted online by CoalZoom.com, Hayes, a Casa Grande, Arizona resident and editor-in-chief of *American Coal* magazine, attributes coal's current decline to market pressures from the effects of lower energy demand — a trend observed since the Great Recession. "People aren't using things the way they did before," he says. "They're saving instead of buying."

Another factor hindering the growth in coal, Hayes points out in the *Dispatch* article, are regulations that make it difficult for facilities to stay compliant with the government's expectations. "There is definitely reason to be concerned in the sense of how the industry is being treated by the federal government," he emphasizes.

The *Dispatch* further notes that the U.S. Supreme Court is reviewing rules set by the U.S. Environmental Protection Agency, requiring all states to submit new carbon-reducing plans that meet rate-based goals by 2030. Twenty-nine states, many of which are dependent on the coal industry, have rallied together to legally challenge the EPA rules.

Finally, Hayes comments that coal companies in bankruptcy court does not indicate a complete shutdown of the industry, as companies will continue operating despite the higher costs it takes to extract and deliver coal. "It is not unusual given the current state of our markets right now," he says. "It's also not the end of the world."

January 2017

New Federal Policy Preps U.S. Industry For Production of Automated Vehicles

By Steven J. Storts
Dublin, Ohio

IN A MOVE largely anticipated by the U.S. automotive industry, the federal government recently issued a new policy for automated vehicles, laying the groundwork for their testing and future deployment. The Federal Automated Vehicle Policy, released in September by the U.S. Department of Transportation, sets a proactive approach toward providing safety assurance and facilitating innovation in several ways.

For instance, the new DOT vehicle performance guidance uses a 15-point safety assessment to set clear expectations for manufacturers developing and deploying automated vehicle technologies. Also included is a model state policy section delineating federal and state roles in regulating highly automated vehicle technologies aimed at building a consistent framework of laws to govern self-driving vehicles.

Finally, the policy outlines options regarding the use of current federal authorities to expedite the safe introduction of highly automated vehicles into the marketplace and discusses new tools that may be necessary as the technology evolves and is deployed more widely.

A recent study by the John A. Volpe National Transportation Systems Center notes that current Federal Motor Vehicle Safety Standards do not directly address automated vehicle technologies and often assume the presence of a human driver. Traditionally, those standards can take years to develop and are usually implemented after the new technologies have made significant market impact. More importantly, existing FMVSS language could create certification challenges for automated vehicle manufacturers choosing to pursue certain vehicle concepts. The new policy, though, envisions greater transparency as DOT works with manufacturers to ensure that safety is appropriately addressed on the front-end of development.

Overall, the Volpe study reveals that there are few barriers for automated vehicles to comply with FMVSS, as long as the vehicle does not significantly diverge from a conventional vehicle design. However, standards for theft protection, roll-away prevention, and light vehicle braking systems were identified as having potential issues for automated vehicles with conventional designs.

"Ninety-four percent of crashes on U.S. roadways are caused by a human choice or error," says Mark Rosekind, administrator of the National Highway Transportation Safety Administration. "We are moving forward on the safe deployment of automated technologies because of the enormous promise they hold to address the overwhelming majority of crashes and save lives."

The NHTSA administrator's remarks come in the wake of the May crash of a Tesla Model S on a divided highway in Williston, Fla., near Gainesville. The driver, Joshua Brown, 40, a technology entrepreneur from Canton, Ohio, was using Tesla's signature Autopilot system at the time of crashing into the side of a tractor-trailer. The vehicle's camera system failed to distinguish between a bright sky and a white tractor-trailer and, consequently, failed to automatically activate the braking system. The Tesla accident is the first U.S. fatality in a wreck involving a car in self-driving mode.

Transportation Secretary Anthony Foxx points out, "Public input has been essential to getting this right. There has been a strong call from state and local governments, industry, safety experts, mobility advocates, and average Americans to establish a clear policy for the deployment of automated vehicles on our roads." He further adds, "There are huge upsides and significant challenges that come with automated vehicle technology, and we will continue the conversation with the public over the coming months and years as this technology develops."

Although the primary focus of DOT's new policy is on highly automated vehicles, those vehicles that can take full control of the driving task in at least some circumstances are addressed, too. There are also portions of the policy that apply to lower levels of automation, including some of the driver-assistance systems already being deployed by automakers today.

Simultaneously with the Federal Automated Vehicle Policy, NHTSA is releasing a final enforcement guidance bulletin clarifying how its recall authority will also apply to automated vehicle technologies. Specifically, the agency emphasizes that semi-autonomous driving systems that fail to adequately account for the possibility that a distracted or inattentive driver-occupant might fail to retake control of the vehicle in a critical situation may be defined as an unreasonable risk to safety and subject to recall.

In a statement following Brown's death, Tesla stressed both the impor-

tance and uncertainty regarding its new Autopilot system, emphasizing that drivers still have to manually enable it. According to Tesla's statement, Autopilot is an "assist feature" requiring a driver to keep both hands on the wheel at all time. Drivers are told they need to "maintain control and responsibility" for their vehicles while using the system, and they have to be prepared to take over at any time.

The Associated Press reports that automatic braking systems have malfunctioned in other vehicles, too, and several have been recalled to correct problems. Last fall, Ford recalled about 37,000 F-150 pickups because they braked with nothing in the way. The company stated that the radar system could become confused when passing a large, reflective truck.

Industry analysts point out that warning technologies rely heavily on multiple cameras, radar, lasers, and computers to sense objects and determine if they are in the vehicle's way. Unfortunately, these systems are not yet sophisticated enough to overcome deficiencies such as subtle color variations or blindness from bright or low-contrast light.

One of the more overlooked ironies during the evolution of self-driving vehicles is the fact that last year, the 2015 American Customer Satisfaction Index found that satisfaction with automobiles dropped for the third straight year (nearly four percent) to the lowest level since 2004. Automakers recalled a record 64 million vehicles for problems such as exploding air bags and ignition switches that can unexpectedly cause engines to stall — all problems that can lead to fatalities. Fortunately, this year's survey shows a 3.8 percent rebound in customer satisfaction, up from 79 to 82 out of ASCI's scale of 0 to 100.

Mass-market vehicles have made considerable headway in 2016, according to ASCI data, and while drivers report that their quality has improved, lower prices have also contributed to the rise in buyer satisfaction. Incentives increased by 13 percent during the first two quarters of 2016, more than offsetting impacts from recalls. ACSI data also indicate that nearly the same percentage of survey respondents reported recalls this year as in 2015, yet overall customer satisfaction with the auto industry is up.

October 2016

Industrial Modernization En Route With Additive Manufacturing Processes

By Steven J. Storts
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THE buzz regarding additive manufacturing — often referred to as 3-D printing, rapid prototyping, or direct digital manufacturing — is an interesting phenomenon to say the least. However, AM technologies are certainly not new by today's standards, having been extensively research and developed for commercial use in the 1980s. Perhaps what is more revolutionary (or evolutionary) is the wide range of AM applications coming to fruition.

Thought improbable just a few decades ago, additive manufacturing is now fabricating products for use in aircraft, dental restorations, medical implants, automobiles, and the fashion industry. Foreseeable projects could benefit the construction industry in support structures as well as industrial machine fabrication and open the doors for basic consumers to create, customize, or repair their own personal products.

In its most basic form, AM is described by California-based Amazing AM, the online publisher of AdditiveManufacturing.com, as a series of technologies that builds 3-D objects by adding layer-upon-layer of material, whether the material is plastic, metal, ceramic, concrete, or perhaps one day, human tissue aimed at producing human organs.

For example, instead of milling a workpiece from a solid block, using a more traditional machining process, AM builds up components layer-by-layer using available materials. As its key advantages, additive manufacturing allows for quality fabrication of parts with very complex geometries, all without tooling, fixtures, and producing any waste material.

Common to all AM technologies is the use of computers, 3-D modeling or computer-aided design software, machine equipment, and layering material. Once a CAD schematic is produced, the AM equipment reads in data from the CAD file and lays downs or adds successive layers of liquid, powder, sheet material or other composites, in a layer-upon-layer fashion, fabricating a 3-D object. Depending on the material used, components can be manufactured using stereolithography, laser sintering, or 3-D printing.

Amazing AM notes that although the layer-upon-layer approach is somewhat simplistic in nature, there are numerous degrees of sophistication that exist within AM technology applications to meet a wide range of needs. Some of these include visualizing a tool in design or industrial tooling, creating highly customized products for both consumers and professionals, and producing small lots of production parts.

The benefits of AM applications are also numerous: reduced weights for new designs; mass customization of new delivery models; cost savings on custom tooling; reduced assembly steps and improved quality control; reduced inventory due to on-demand production; and faster delivery times to market.

Well-known industry consultant and analyst Terry Wohlers of Denver, Colo., who keynotes numerous events for the Society of Manufacturing Engineers and other organizations worldwide, states in one of his reports, "Additive manufacturing technologies create a world of possibilities that can take an organization in an entirely new direction and help launch new businesses and business models. 3-D printing and 3-D imaging are causing design and manufacturing professionals to rethink their approach to new product development."

Manufacturing engineers are also extending their design capabilities as advancements in AM technologies offer more complexities, geometric shapes, and features. "Low-cost 3-D printers are affecting both the professional and consumer markets," Wohlers says. "The increased sale of these machines over the past few years has taken additive manufacturing mainstream more than any other single development. As new additive manufacturing systems and materials become more widely adopted, I expect to see new designs that previously would have been very difficult or too expensive to manufacture."

One of the more innovative applications of AM technologies is currently underway at General Electric Aviation in Cincinnati, Ohio. Making a radical departure from its traditional manufacturing platform, GE is producing a fuel nozzle for a new aircraft engine by 3-D printing the part with lasers, rather than casting and welding the metal. GE chose the additive process for the project because it uses less material than conventional techniques, thereby reducing production costs and yielding significant fuel savings because of the lighter material weight.

The initial challenge for GE was to eliminate as many unknowns as

possible, starting with the material. "When we designed the nozzle, we wanted to make it from an alloy that was mature, well-known and thoroughly tested, nothing exotic," says Todd Rockstroh, a GE laser processing expert.

Rockstroh and his team settled on cobalt-chromium alloys, which have been used for decades for human joint replacements and dental implants. Light, tough, and corrosion-resistant, these alloys can operate in temperatures as high as 1,800 degrees Fahrenheit and are relatively inexpensive. Because the AM process requires powdered metal, specialty smelters are being deployed that can turn molten alloys into powder through gas atomization, mechanical milling, spray forming, and other advanced methods.

A computer file of the digitized drawing of the nozzle guides the 3-D printer's high-powered fiber optic laser across the powder bed, much like a painter moves a brush across the canvas. The laser then fuses successive layers of powder — each 20 microns thick — to the desired shape. The end result is a fuel nozzle that is 25 percent lighter and as much as five times more durable than the current nozzle made from 20 different smaller parts welded together.

Although AM technologies are trending upward in manufacturing, surprisingly, many companies are still unaware of additive manufacturing's projected potential over the next decade, according to the New York-based management consulting firm McKinsey & Company. A McKinsey survey of leading manufacturers earlier this year showed that 40 percent of the respondents were unfamiliar with AM technology "beyond press coverage." An additional 12 percent indicated that 3-D printing might be relevant but more information is needed to make a determination.

Many companies in the McKinsey survey also admitted they were ill-prepared to undertake a cross-organizational effort to identify the opportunities. In fact, two-thirds of respondents said their companies lacked a formal, systematic way to catalog and prioritize emerging technologies in general.

Nevertheless, 10 percent of those executives surveyed consider AM technologies "highly relevant." They see 3-D printing's ability to increase geometric complexity and reduce time to market as the key business benefits, closely followed by reduced tooling and assembly costs and reduced inventories of spare parts.

April 2015

U.S. Geological Effects of Hydraulic Fracturing Need More Study, Research

By Steven J. Storts
Dublin, Ohio

ONE of the great debates surrounding the oil and natural gas extraction process of hydraulic fracturing, commonly known as "fracking," centers on alleged geological side effects, namely the recent rise in earthquakes in states such as Arkansas, Colorado, Kansas, Ohio, Oklahoma, and Texas. Not surprising, this issue could also prove as contentious as discussions regarding man-made global warming (climate change) due to a lack of sustained, conclusive scientific research. The question, of course, still remains: Are earthquakes occurring naturally or coincidentally in regions where fracking is underway or are they being caused or exacerbated by fracking or its residual wastewater injection through underground wells?

Extracting oil or natural gas from certain formations deep underground, including shale, tight sandstones, and coal beds, requires drawing the resource through openings about one-half the width of a human hair. The process uses water pressure and a sand-and-chemical mixture to produce a myriad of hairline fractures within the underground rock formations through which oil or natural gas can flow. The contaminated water returns to the surface, requiring treatment, and then disposal through a wastewater injection well, designed specifically for this purpose. It is the large volume of discharged wastewater, not the fracking itself, which is being targeted as the primary source for triggering earthquakes by pressuring and lubricating geological faults.

The U.S. Geological Survey and Oklahoma Geological Survey report that the state experienced more than 180 quakes of 3.0 magnitude or greater from October 2013 to early May of this year. Most were too weak to cause any property damage or endanger lives. Nevertheless, the recent number of quakes contrasts sharply with an average of only two such events from 1978 to 2008. For reference purposes, a 3.0 magnitude earthquake is described by USGS as causing "vibrations similar to the passing of a truck." More recently in July, during a span of only 14 hours, USGS recorded seven small quakes ranging from magnitude 2.6 to 2.9, all centered in the Guthrie, Jones, and Langston areas, 15 miles to 30 miles northeast of Oklahoma City. Those quakes followed four others a day earlier, including a magnitude 4.3 tremor near Langston and the other three ranging in magnitude from 2.9 to 3.2.

Near Azle, Texas, Southern Methodist University researchers have recorded more than 300 quakes since December last year and are studying the premise of whether wastewater disposal wells in Azle and around North Texas are stimulating fault activity or if earthquakes are occurring naturally. USGS reports that North Texas has had 70 earthquakes since 2008, compared with just a single quake recorded in 1950 before then. SMU researchers also studied two other earthquake sequences in North Texas and concluded there was a plausible link between the quakes and nearby injection wells. Other seismologists, however, note that a clear correlation has not been established, aside from a contention that injection well operators could simply be pumping either too much water into the ground or pumping it at exceedingly high pressures.

Still, because the earthquake rate in Oklahoma has risen by nearly 50 percent since October 2013, both USGS and Oklahoma Geological Survey emphasize that the recent increase is not due to typical, random fluctuations in natural seismicity rates. Instead, the agencies indicated earlier in May that a likely contributing factor to the notable seismic activity is deep-injection wastewater disposal. Consequently, Oklahoma recently enacted new testing and monitoring regulations for injection wells that require well operators to collect daily information on well volume and pressure, instead of monthly. The state has also increased the number of seismic monitoring stations and now operates a network of 15 permanent stations and 17 temporary stations.

Back in the Midwest in Ohio, a geological investigation into five small tremors in the Youngstown area last March found a probable link to hydraulic fracturing caused by increased pressure on a small, unknown fault in a Utica Shale bed. While earlier studies had linked minor quakes in the same region to wastewater injection wells, this marks the first time that tremors have been tied directly to fracking, according to the Oil and Gas Resources Management Division of the Ohio Department of Natural Resources.

In response to Ohio's recent seismic events, the state has issued new permit conditions. All new drilling sites within three miles of a known fault or seismic activity of 2.0 magnitude or

higher will be conditional on the installation of sensitive seismic-monitoring equipment. The results will be directly available to regulators, so the state will not be reliant on drilling operators providing the data voluntarily. If seismic activity of 1.0 magnitude or greater is felt, drilling will be paused for evaluation, and if a link is found, the operation will be halted. Ohio has also imposed an indefinite drilling moratorium at the site of the March quakes but is allowing oil and natural gas extraction to continue at five existing wells at the site.

Part of the reluctance toward labeling fracking as the sole cause for recent earthquake activity is the fact that the process is not new. In fact, this year the American Petroleum Institute is celebrating the 65th birthday of hydraulic fracturing. From an industrial perspective, hydraulic fracturing has been used on more than a million wells nationwide and already accounts for the majority of U.S. natural gas production. And according to the Society of Petroleum Engineers, of the more than 150,000 Class II injection wells in the United States, only about 40,000 are waste fluid disposal wells for oil and gas operations, with only a handful having been proven to induce quakes that are large enough to concern the general public.

Preliminary findings of ongoing USGS research indicate that hydraulic fracturing itself does not appear to be linked to the increased rate of magnitude 3.0 and larger earthquakes in the United States. And although wastewater injection has not yet been linked to large earthquakes of magnitude 6.0 or higher, engineers and scientists cannot eliminate the possibility, USGS notes. For instance, there is consensus that wastewater disposal induced the magnitude 5.3 earthquake in Raton Basin, Colo., and the magnitude 5.6 quake in Prague, Okla., both in 2011. However, USGS researchers have also found that earthquakes induced by fluid-injection activities are not always located close to the point of injection. In some cases, the induced quakes have been located as far as six miles from the injection well.

Currently, there are no methods available to anticipate whether a planned wastewater disposal activity will trigger earthquakes that are large enough to be of concern, the U.S. Department of the Interior points out. Evidence from some case histories suggests that the magnitude of a quake tends to increase as the total volume of injected wastewater increases. Injection pressure and rate of injection may be factors, too, but more research is needed for conclusive results.

October 2014

Manufacturing Innovation Network Sparking Wide Interest, Attention

By Steven J. Storts
Dublin, Ohio

THERE has been recent "buzz" within the industrial community that American innovation is slowly coming back to the forefront of domestic research and development. Among that mindset is a pilot program — the National Network for Manufacturing Innovation — which was launched in 2012 and is now beginning to attract attention from much-needed stakeholders, namely Congress and the private sector.

As originally proposed in 2011 by the Obama administration, NNMI aims to build an initial network of 15 research institutes, all focusing on developing and commercializing competitive manufacturing technologies through public-private partnerships between U.S. industry, universities, and federal government agencies.

Each Institute for Manufacturing Innovation will be tasked with a unique research concentration and will serve as a regional hub for innovative manufacturing R&D advancement. NNMI's longer-term goal is an expansion up to 45 IMIs.

A pilot institute was established in Youngstown, Ohio, in August 2012, initially funded with $30 million from federal agencies and an additional $40 million from private resources. Utilizing the financial backing of more than $300 million from both federal and private resources, three additional IMIs located in Raleigh, N.C., Chicago, and Detroit recently began operations in January and February. Collectively, these organizations will:

- Assist the United States to grow its capabilities in 3-D printing, also known as additive manufacturing, by fostering collaboration in design, materials, and technology;
- Focus on enabling energy-efficient, high-power electronic chips and devices by making wide bandgap semiconductor technologies more cost competitive with current silicon-based power electronics;
- Enable interoperability across the supply chain, develop enhanced digital capabilities to design and test new products, and reduce costs in manufacturing processes across multiple industries; and
- Develop processes that accelerate scale-up of production of lightweight alloys for use in wind turbines, air frames, medical devices, combat vehicles, and other products, leading to significant reductions in manufacturing and energy costs.

NNMI is also a vital component of the bipartisan Revitalize American Manufacturing and Innovation Act of 2013 (S. 1468), which was passed out of the Senate Commerce Committee in early April. The research centers proposed in S. 1468 for the development of next-generation manufacturing R&D would be modeled on the IMI hubs already established by President Obama, using existing funds redirected from other agencies and private contributions, mostly from industry stakeholders. A companion bill to the Senate measure has been introduced in the House of Representatives (H.R. 2996) and was referred to committee last August.

"Research and development is a critical piece of the innovation pipeline that feeds our growing manufacturing sector and creates high-quality jobs," says Sen. Christopher Coons (D-Del.), one of the bill's cosponsors. "Manufacturers invest more in R&D than any other sector, but high costs and significant risk often limit the scope and impact of their efforts. Manufacturing innovation institutes would leverage limited resources by bringing researchers and manufacturers together to spur innovation, commercialize R&D, and create good jobs."

More recently, the Information Technology and Innovation Foundation praised NNMI's inclusion in President Obama's 2015 budget proposal, earmarking a $1 billion appropriation. ITIF President Robert Atkinson emphasizes, "The United States is in a global race for innovation advantage and must create new conduits for improving the technological capacity and competitiveness of our manufacturing firms or risk falling further behind our international competitors."

The Society of Manufacturing Engineers supports a similar contention. In its report *2014: Manufacturing's New Momentum*, Manufacturing Engineering Media, SME's media division, states, "After decades of losses of work, factories, and jobs, the U.S. manufacturing industry has clear momentum again, no matter how moderate it might be, and how uncertain it might feel to those still feeling the sting of the Great Recession."

The report notes that technological innovation is leading a U.S. manufacturing renaissance that has the potential to bring work back to America for years to come, and that the trend is sustainable if the nation continues to in-

vest in developing advanced manufacturing technologies and a highly skilled workforce.

There is room for optimism, despite a faltering economic recovery. The U.S. trade deficit narrowed to $34.3 billion in November 2013, according to the report's findings, and although much of that narrowing was due to decreased petroleum imports, the value of exported goods also rose to $137 billion — an all-time high. Total manufacturing exports totaled $1.2 trillion for the 12-month period ending in September 2013, an increase of 38 percent since 2009.

Nevertheless, obstacles still remain, the report emphasizes. Finding enough skilled workers for advanced manufacturing jobs is a major concern, with shortage estimates of the skills gap ranging as high as 600,000 workers. While the depth of the skills gap is open for debate, there is little doubt that it will widen during the coming years due to an aging workforce and a lack of qualified candidates. Despite the challenges, though, the manufacturing industry is poised for continued growth, particularly in the aerospace, automotive, and energy sectors, the report forecasts.

Ian Fletcher, recognized author and commerce and trade columnist for *The Huffington Post*, addresses a different approach for NNMI's mission. In a *Post* blog, he says, "It follows that the key question that will need to be asked, whenever NNMI considers funding some project, is whether it is being asked to fund something that the private sector *should* be funding on its own." He recommends that NNMI should seek out projects that have the following characteristics:

- They involve developing technologies where much of the benefit will "leak" to parties not compelled by patent or other regulation to help defray the cost of developing them.
- They involve developing technologies whose payoff, though substantial, will occur beyond an approximately seven-year time horizon.

"These two key issues are a highly abstract description of the problems involved," Fletcher adds, "and they ramify enormously and interact with other issues — giving rise, for example, to the notorious 'valley of death' problem in innovation . . . . But getting these issues right will be fundamental to any successful, active industrial policy."

April 2014

Growth Analysts Projecting Modest Rise in Industrial Activity in 2013

By Steven J. Storts
Dublin, Ohio

AMID political wrangling on Capitol Hill and fluctuating employment reports, what can the industrial community anticipate in terms of a production outlook for this year and beyond? The forecast has some encouraging signs, more than one might expect in light of a gross domestic product (GDP) that increased only 0.4 percent in the fourth quarter of last year. An ideal growth rate, one that also keeps inflation in balance, should be at least two percentage points higher.

Even with some stagnation in production output, though, Industrial Info Resources Inc. cites growth activity in numerous industries, particularly manufacturing. According to data from its North American industrial database, IIR notes that more than 200 grassroots plants were slated to begin operations in the first quarter of this year, yielding a potential for 17,000 new jobs in the United States and Canada.

Additionally, more than $2.7 billion in project activity is scheduled for startup in the second quarter, expected to create 6,700 jobs nationwide. Aside from manufacturing, the food and beverage, oil and gas, metals and minerals, and pharmaceutical-biotech industries have the most planned expansion opportunities for both quarters. And as in previous years, the Southeast and Mid-Atlantic regions are projected to outpace other U.S. regions in plant startups.

Here is some recent industrial expansion news as reported by Industrial Info:

- More than 230 construction projects for the chemical processing industry are likely to begin in 2013, with a total investment value exceeding $11 billion.
- Bridgestone Metalpha USA Inc., a subsidiary of Bridgestone Americas Holdings Inc., has started construction on a $75 million expansion of its tire cord-manufacturing plant in Clarksville, Tennessee.
- Despite weak metal prices and a difficult 2012, Alcoa Inc. has seen improvement during the first quarter of 2013 and is reporting stronger profits, with more than $6 billion in active projects.
- For 2013, about $982 million in industrial manufacturing projects are set to launch between April and June in the Great Lakes region.
- The U.S. oil and gas industry will spend about $40 billion this year, exceeding the $33 billion expended in 2012.

On a different front, a recent quarterly business outlook survey by the Manufacturers Alliance for Productivity and Innovation shows a slight improvement over previous quarterly reports, implying that the manufacturing sector is holding steady during an uncertain economy. MAPI's March composite index advanced to 56 from 55 in the December 2012 survey, breaking a string of 10 consecutive quarterly declines.

"The March survey results offer a mixed bag," says Donald Norman, MAPI senior economist and survey coordinator. "On the positive side, the composite index ended a long slide, and there is good news in the upswing in the investment indexes and in the profit margin index. Most of the other indexes, however — including current orders, prospective shipments, exports, backlog orders, and capacity utilization — all fell. The outlook over the next three to six months remains the same: growth at a slow pace."

Following Japan's announcement that it will join the Trans-Pacific Partnership negotiations, the National Association of Manufacturers applauded the move. Canada and Mexico have already signed on to the negotiations on a comprehensive basis. NAM President and CEO Jay Timmons emphasizes, "A successful and ambitious TPP agreement will open up new opportunities in overseas markets and eliminate barriers for U.S. exports, sustaining and creating jobs for American workers."

NAM points out that significant work still remains to ensure that U.S. manufacturers gain a level playing field and meaningful access to Japanese markets and other venues. The Business Roundtable touts balanced trade for both imports and exports, which supports more than one in five American jobs. Moreover, U.S. exports account for nearly 14 percent of the GDP, and an estimated 61 percent of imported goods are inputs or components used by U.S. companies.

In its National Activity Index report, the Chicago Federal Reserve stated that industrial production rebounded in February from lower statistics a month earlier, increasing 0.8 percent. The modest increase helped boost manufacturing's contribution to the NAI by 0.34 points, a reversal of a 0.30 decline in January.

However, as 2013 moves forward, Industrial Info is observing some changing trends in planned projects and industrial spending. On the whole, IIR says the value of active projects in North America has declined seven percent annually for the last several years, falling from $482.28 billion in January 2012 to $449.92 billion January 2013. The larger upticks have been in the petroleum refining industry ($12.6 billion) and the chemical processing industry ($10.9 billion). Planned projects may not always move forward, IIR explains, because contractions in product demand, financing issues, and other mitigating circumstances can often lead to project fallout in industrial spending.

Of course, market trends and perceptions also play an important role in forecasting industrial activity. For instance, global automotive sales have been healthy in 2013, up nearly seven percent over last year in the United States alone. Industrial Info reports a sales volume projection that could reach 17 million units by the end of the year, matching pre-recession sales figures. Surprisingly, although numerous vehicle recalls have been well-publicized worldwide for the last several months, total sales to date have not been adversely affected by issues regarding quality.

Unfortunately, the computer industry is not reflecting the same marketplace success as its automotive counterpart. Hewlett-Packard, Dell, and Intel have shown steady losses in worldwide sales of desktop PCs, according to the International Data Corporation. The 76.3 million PC shipments during the first three months of 2013 is a decline of about 14 percent from the same period in 2012, far exceeding analysts' loss predictions of more than seven percent. One of the reasons for this decline, IDC contends, is that Microsoft's new Windows 8 "touch" operating system, with its radical changes to the user interface, has made PCs less attractive in terms of costs and familiarity as compared to tablets, smartphones, and other mobile devices.

March 2013

Oil Shale Garnering More Industry Attention, But Still Has Obstacles

By Steven J. Storts
Dublin, Ohio

IT is estimated that the oil shale potential in the western United States could yield an amount of oil greater than the proven petroleum reserves in the Middle East. And if fully developed, oil shale could supply the current U.S. consumption of oil for more than 70 years. Some studies forecast even higher estimates. A Rand Corporation report points out that the current domestic demand for petroleum products is about 20 million barrels per day. If oil shale could be used to meet a quarter of the daily demand, the recoverable resources could last for more than 400 years.

Consequently, the magnitude of this energy resource potential is making it attractive for some energy industry stakeholders to invest in its development, or at least take a second look at its viability — something that was briefly explored and then abandoned in the early 1980s due to excessively low oil prices and a lack of advanced cost-effective technologies. Estonia and China already have well-established oil shale industries, and Brazil, Germany, and Russia currently utilize oil shale for various uses. Australia recently commissioned its pilot demonstration oil shale plant in Queensland to begin the production phase.

The largest known oil shale deposits in the world are in the Green River Formation, an area spanning portions of Colorado, Utah, and Wyoming, with earlier oil estimates ranging from 1.5 to 1.8 trillion barrels. In 2011-2012, though, the U.S. Geological Survey increased its estimate of the amount of oil shale contained in the region to more than four trillion barrels, but not all resources in place are recoverable. Rand notes that potentially recoverable oil ranges roughly from 1.1 trillion barrels on the upper scale to about 500 billion barrels on the lower side. However, the research organization emphasizes that for policy planning purposes, any amount of oil in this range is very substantial and worthy of consideration for development.

Low-cost oil shale commercialization would, of course, yield tangible benefits, including reduced world oil prices, increased employment, and bolstered national security due to less dependence on foreign oil imports. Additionally, direct economic profits could range as high as $20 billion annually for an oil shale industry producing just three million barrels per day. Rand reports that through lease bonus payments, production royalties, and corporate income taxes, roughly half of these profits would likely go to federal, state, and local governments, thereby broadly benefitting the public at large.

The National Oil Shale Association admits that commercial operations cannot occur over night, but they could evolve in a methodical manner over years to achieve production levels in the range of 1.5 to 3.0 million barrels per day, which translates upwards to 40 percent of the U.S. oil imports from OPEC countries in 2012 and 100 percent of the oil imported from the OPEC Persian Gulf countries. NOSA adds, however, there are critical issues that must be addressed before successful commercialization of oil shale can be realized cost effectively. Some of these include land use and ecological impacts, air quality, greenhouse gas emissions, water quality and consumption, socioeconomic impacts, leasing restrictions, and market risks.

Additionally, some confusion exists among the general public and the media regarding the term "oil shale," which is often used synonymously — and sometimes incorrectly — with "shale oil," also called "tight oil" or crude oil. Oil shale contains an organic chemical compound known as kerogen, from which liquid hydrocarbons called shale oil can be extracted via high temperatures and vaporization, using either surface or underground retorting technologies. Oil-bearing shale (shale oil), on the other hand, actually contains petroleum elements or crude oil, which is extracted through an underground hydraulic fracturing process.

Shale oil is often found near drilled wells or known oil reserves, with significant deposits located in Saskatchewan, Canada, and extending southward through Montana, the Dakotas, Nebraska, Kansas, Oklahoma, and into Texas. Ohio and other Midwest regions have documented large shale oil deposits, too.

Water management is a key element in the oil shale landscape because direct consumptive water requirements range from one to three barrels of water for every barrel of oil shale produced, depending upon the recovery technology being employed. However, NOSA points out that the quality of the required water also varies for commercial oil shale projects, and much can come from

non-potable sources. For instance the waste water currently produced from the oil and natural gas wells and coal-bed methane wells may be treated and used for various uses within an oil shale complex.

Moreover, the amount of water necessary for oil shale development compares favorably with other energy sources, according to NOSA. The consumption is much less that ethanol produced from irrigated crops and not significantly greater than fuel generated from conventional petroleum resources. Also, the required amount of water will likely be less as more advanced technologies evolve and alternative sources of water are developed.

Perhaps the greatest challenge for the oil shale industry currently lies in leasing rights and restrictions. The U.S. Bureau of Land Management controls more than 70 percent of the western oil shale resource. In 2008, BLM published a Programmatic Environmental Impact Statement that amended 10 resource management plans in Utah, Colorado, and Wyoming to make about two million acres of public lands potentially available for commercial oil shale leasing and development and 430,000 acres potentially available for tar sands leasing and development.

However, in spring 2011, BLM initiated a new planning effort to reassess the appropriate mix of public lands to be made available for oil shale and tar sands leasing. In November last year, new PEIS regulations for eight land use plans in Colorado, Utah, and Wyoming were issued. BLM's preferred alternative now reduces the leasing acreage available for new oil shale development projects to 676,967 acres and to 129,567 acres for tar sands development. Also, the new regulations only authorize research, development, and demonstration projects, which can be later converted to commercial leases when all conditions and regulations of the RD&D lease have been satisfied and all further environmental reviews and public comment periods have been conducted.

Currently, there are oil shale projects or applications under operation or development by American Shale Oil, AuraSource, Colorado Energy Research Institute, ConocoPhillips, Enefit American Oil, Energy Dynamics Laboratory, Enshale, Exxon Mobil, Genie Energy, Hatch, Idaho National Laboratory, Natural Soda Holdings, Red Leaf Resources, Sage Geotech, Shell Mahogany Research, and Total.

January 2013

Industry Leadership Still Necessary To Advance Ethical Principles

By Steven J. Storts
Dublin, Ohio

IT has been more than two decades since a Business Roundtable study debunked the myth that there is an inherent contradiction between ethics and profits, emphasizing that sound values, purposes, and practices are the basis for long-range achievement and bottom-line success. Although this finding was deemed somewhat controversial by some advocacy groups seeking financial reforms in the large industrial community, the engineering profession as a whole embraced the Roundtable report, *Corporate Ethics: A Prime Business Asset*, and continues to do so today.

With information gathered from 100 companies, the Roundtable cited the crucial role of chief executive officers and top managers in establishing a strong commitment to ethical conduct and providing constant leadership in tending and reviewing the values of the organization. Equally important, there should exist a deep conviction among managers that a good reputation for fair and honest business is a vital corporate asset that all employees should nurture with the greatest care.

The study further recognized the need for corporate obligations to extend to a variety of constituencies or stakeholders, and that these responsibilities are key to the ethics of an organization. Customers, shareholders, employees, suppliers, local communities, and the larger society are basic constituencies that must be considered in planning and evaluating ethical policies and actions. Carrying out all corporate obligations requires a comprehensive ethical perspective that is understood and acted upon throughout every sector and all levels of an organization.

"It may come as a surprise to some that corporate ethics programs are not mounted primarily to improve the reputation of business," the report noted. "Instead, many executives believe that a culture in which ethical concerns permeate the whole organization is necessary to the self-interest of the company. This is required, they feel, if the company is to be able to maintain profitability and develop the necessary competitiveness for effective performance."

While no organizational code or standard can address all potential ethical issues, the following provides a good foundation of ethical areas or topics to consider:

- Fundamental honesty and adherence to basic laws and moral conduct;
- Product safety and quality;
- Health and safety in the workplace;
- Conflicts of interest;
- Employment policies;
- Fairness in selling and marketing practices;
- Financial reporting;
- Supplier relationships;
- Pricing, billing, and contracting;
- Trading in securities and using inside information;
- Payments to obtain domestic or foreign business;
- Acquiring and using information about others;
- Political activities;
- Protection of the environment;
- Intellectual property and security of proprietary information;
- Protection to employees for reporting violations; and
- Disciplinary action for ethical misconduct.

In 2009, the Arthur W. Page Society and the Business Roundtable Institute for Corporate Ethics released a new related report, *The Dynamics of Public Trust in Business: Emerging Opportunities for Leaders*. As the title suggests, the document examines three core dynamics of trust — mutuality, balance of power, and trust safeguards — and then proceeds to discuss successful trends in conducting responsible businesses, eliminating or reducing mistrust, and engaging public confidence.

The report reviews several fundamentals. First, to build and sustain trust at the most basic level, an organization must manufacture and market quality products or services that are reasonably priced. A business also needs to provide steady jobs in a safe and healthy environment and to support community institutions that serve both employees and customers. Finally, an organization must provide shareholders with a reasonable return on their investments. Beyond these fundamentals, the report recommends specific actions that industry leaders might consider in building mutuality, balancing power, and creating trust safeguards within their organizations:

- Create a set of values that define and clarify what the business en-

terprise and its stakeholders are at their root or foundation and then work to ensure that these values are adhered to consistently;

- Build and manage strong relationships based on mutual trust with mediating institutions;
- Embrace transparency and open communication;
- Work within a targeted business sector to build trust in that sector; and
- Reinvest in the trustworthiness of the organization by making a commitment to enhance the core contribution that the organization makes to society at large.

It is fact that in changing any standard of living for the better, globally or domestically, risks must be taken, and further responsibilities must be accepted by everyone — engineers, scientists, and the public alike. However, because basic engineering principles are not always consistent with perceived principles of safety and public health, the public must always be informed prior to entering unknown territory, and that discussions of risks vs. potential benefits call for transparency and forthright explanations.

Moreover, ethical conduct is often equated with moral responsibility and professional integrity. William Scheessele, president and CEO of Mastering Business Development Inc., a business consulting services firm based in Charlotte, N.C., says it is evident that some of the underlying errors in thinking, responsibility, and judgment still remain from the "new economy" mentality that tarnished the reputation of solid, old guard industries.

The Sarbanes-Oxley legislation passed in 2002 has not fostered long-term ethical choices, either, according to Scheessele. In an article titled "Ethics in the Energy Industry Revisited," he notes that the ethics issue goes much deeper into the character of a professional, and that integrity cannot be legislated into adherence at any price. The energy industry requires well-qualified technical professionals with the knowledge base to solve current and future global energy challenges.

Following the Enron scandal, the power industry took a major step forward by looking internally to its people, largely engineers and technical professionals with a higher set of standards for their actions, Scheessele explains. "It is from our experience that the more highly technical an industry is, the better to encourage the technical professionals on staff to be at the forefront of developing business and growing the bottom line," he contends. "This is true in our opinion because . . . technical professionals know what problems and issues need to be addressed for clients."

Engineers and scientists look externally to solving client problems, Scheessele points out. Sales people look internally at making quotas. In learning to think like a business person, an engineer can look at the business ramifications of a technical issue and think in an externally focused way from the client's point of view to find a solution to the problem. "It's the notion that serving the client should be placed above profit that is inherent in the engineering profession and believing that in the long run, these are not two mutually exclusive concepts," he emphasizes.

October 2012

Industry Recall Trend Idles Some, But Prevention Still the Best Solution

By Steven J. Storts
Dublin, Ohio

FINALLY, some good news may have arrived! The first quarter of 2012 showed signs of curbing the recall trend within the food processing, drug, medical device, consumer product and vehicle industries that has doggedly trailed U.S. businesses since 2008. Federal regulatory agencies have continually pointed to a steady rise in recalls for several years, with 2009 and 2010 posting the worst numbers for voluntary and mandatory recall notices. Last year, though, the number of recalls by major industries declined or began leveling off.

For some businesses, the break from recalls has been a significant improvement; for others, just minor relief, but encouraging nevertheless. For instance, the National Highway and Transportation Safety Administration reported more than 480 nationwide recalls for vehicles and related mobile equipment in 2008, a figure that went beyond 600 a year later and exceeded 530 in 2010. Last year saw a sharp decline to just over 90 recalls — an 80 percent drop. To date this year, only three recalls have been announced.

The food processing industries have been on a rollercoaster scare since 2008 when the Federal Drug Administration and U.S. Department of Agriculture logged almost 200 recalls, followed by more than 900 recalls in 2009 and nearly 360 in 2010. The 370 percent and 220 percent increases, respectively, were primarily due to the recall of contaminated peanuts, tainted farm produce and mislabeled food products. A substantial decline to just over 200 recalls in 2011 eased business concerns somewhat, and so far in 2012, the FDA and USDA have announced less than five recalls.

Medical device manufacturers and drug-related businesses have also seen a rise-and-fall recall pattern. Together in 2008, they posted more than 80 recalls, which rose to nearly 135 in 2009 and exceeded 150 in 2010, with increases ranging from 63 percent to as high as 155 percent. However, there were slight drops for both industries in 2011, according to the FDA, which recorded 120 recalls. As of the first quarter of this year, the recall figure is less than 15.

The most contentious recalls still remain in the consumer products category, such as household goods, power tools and lawn equipment, electronics, clothing, and children's toys. The number of recalls reported in 2008 totaled nearly 400, followed by a small increase in 2009 and decreases in 2010 and 2011 ranging from seven percent to 15 percent. To date this year, just over 80 recalls have been announced by the Consumer Products Safety Commission.

Ironically, most of the recalls between 2008 and 2011 addressed unusual safety risks, including drawstrings in children's garments and certain window blind designs, both of which were linked to accidental strangulation of infants and small children.

Any lessening of the recall affliction is certainly welcomed by industry stakeholders, but the omnipresence of even a minor recall notice is still a harsh distinction from the engineering quality movement and zero-defects mindset made popular just a few decades ago. IndustryWeek.com further notes that strict adherence to certified quality programs aimed at maintaining or improving efficiency may not be enough to change a growing recall trend, as evidenced by the efforts of Toyota, General Motors, Ford, Firestone and some European manufacturers.

Additional special training is necessary in other vital areas that contribute to product accountability, such as risk evaluation, design reviews, safety and hazard analyses, marketing and public relations, interdepartmental communications, responsible contracting agreements, document management and supplier control.

Other industry analysts primarily attribute major product recalls to design flaws — not defective manufacturing — which are resulting in accidents, bodily injury and sometimes death. Whether recalls emanate from defects in design or manufacturing, both contentions can have serious liability implications if companies fail to heed early warning signs that their products are not performing to prescribed standards or customer expectations.

Of course, even the best-laid designs still have the possibility of a defective condition surfacing during the chain of production, Industry Week.com points out. In some cases, a design review or product safety team may fail to consider the more likely misuses of a product. Unfortunately, once a company openly admits that its product is defective and voluntarily initiates a recall, the door also remains open for potential product liability lawsuits. And if a company knowingly withholds in-

formation regarding a defective product and does not issue a recall, the organization becomes willfully negligent and subjects itself to substantially larger punitive damage awards in the courtroom.

With a no-win scenario as the only guaranteed outcome of a product recall incident, it makes good business sense to "do things right the first time." To help mitigate recalls, the CBS Interactive Business Network reports that many companies are taking the approach of developing product integrity or product safety committees to formulate and monitor decisions relating to product design and safety.

These committees typically include representatives from engineering, manufacturing, quality control, legal and other major organizational departments, and are responsible for the following:

- Establishing guidelines and criteria for the evaluation of product hazards;
- Establishing criteria for warnings, labels and manuals;
- Establishing guidelines for advertising, product brochures and other printed materials;
- Coordinating the reviews of all product warranties, exculpatory clauses, disclaimers and liability release statements; and
- Coordinating and issuing notifications to government agencies regarding product defects or noncompliance with safety standards.

As a key to success, any recall prevention program should include companywide safety training and awareness initiatives, followed by the implementation and documentation of all necessary procedures and standard practices for advocating product quality and safety. Additionally, there must be a system in place to measure product safety benchmarks, establish corrective actions and regularly audit the effectiveness of recall prevention efforts.

April 2012

U.S. Automakers Quickly Advancing Affordable Smart Vehicle Technologies

By Steven J. Storts
Dublin, Ohio

ENGINEERS representing the U.S. auto industry have always had that special distinction in bringing cutting-edge vehicle designs and advanced engine technologies to the forefront of manufacturing. But now they can also claim the unique pleasure and satisfaction of delivering smart, intelligent innovations that were once reserved only for luxury vehicles to a new growing popularity—economy class models.

Recognizing the value of bundling selective vehicle options with standard equipment for the average motorist, domestic automakers are now playing it "smart" with their marketing campaigns by promoting affordable intelligent car amenities in three main categories: pleasure, convenience or ease of driving, and safety.

Of course, no one manufacturer spurred the evolution of intelligent vehicles—luxury, sport utility, or economy. The initiative began decades ago with multiple companies, with assistance from numerous private and government research and transportation agencies. Based on a wide range of stand-alone information and communication technologies, the list of smart car creations is impressive. Some are already in use such as anti-lock braking systems and electronic stability control or are being introduced into the market, while others are not yet commercially available or are in the prototype and road-testing phases.

Ford Motor Company offers some of the newer smart systems, including adaptive cruise control, blind spot detection, keyless entry, trailer sway control, terrain management, inflatable rear safety belts, cross-traffic alert, and speed alert, just to name a few. Ford's current media blitz is targeting economy-conscious drivers by touting the intelligent aspects of the new Focus and Fiesta models, in addition to their 40 miles-per-gallon mileage standard certification.

The Focus, for example, showcases the following smart features:

- **SYNC:** sophisticated voice control system for numerous vehicle functions such as hands-free communications, entertainment, and driver assistance.
- **Active Park Assist:** parallel parking with just the push of a button and a few simple steps.
- **MyKey:** programmed system that encourages younger motorists to drive more responsibly and safely.
- **Ambient Lighting:** interior illumination (ice blue, soft blue, orange, red, green, purple, blue, or purple) to reflect the driver's mood.
- **Sony Audio with HD Radio:** theater-quality sound (390 watts of power with 12 Sony speakers) that delivers more AM and FM channels with greater clarity, with no subscription required.

The Fiesta, a renaissance compact vehicle of Ford originally launched in 1976, is not only known for its performance and design, but also for its smart safety enhancements, including passenger sensors that determine occupant weight and seat belt status to optimize airbag deployment force, plus additional sensors that use pressure pulses from a side impact to deploy up to 30 percent faster than traditional airbags with acceleration-based sensors.

Other smart systems newly on the market or under development by vehicle manufacturers include adaptive headlights, driver drowsiness monitoring and warning, dynamic traffic management, electronic brake assist, gear shift indicator, lane departure warning, local danger warning, night vision, obstacle and collision warning, and intersection assistant.

OnStar, a wholly owned subsidiary of General Motors Company, recently announced a navigation enhancement to its RemoteLink mobile application allowing subscribers to search for a destination on their smartphones and send it directly to their vehicle, where the route can then be accessed audibly through OnStar Turn-by-Turn or via an in-dash navigation system. OnStar and Chevrolet announced the auto industry's first mobile app at the 2010 Consumer Electronics Show. Since then, Chevrolet, Buick, GMC, and Cadillac have expanded the use of OnStar technology in launching additional mobile apps for newer model years.

Another GM smart innovation will be unveiled in the 2012 GMC Terrain featuring the industry's first crash-avoidance system that exclusively uses a single camera to help drivers avert front-end and no-signal lane departure crashes. Terrain's new active safety system uses a high-resolution digital camera mounted on the windshield ahead of the rearview mirror that looks for shapes of ve-

hicles and lane markings. The system uses audible warnings and a high-mounted visual display to warn the driver if he or she is following another vehicle too closely or is departing a lane without signaling first, or when a collision is imminent.

Chrysler is keeping pace with intelligent technology, too. In 2009, the company became the first U.S. automaker to offer live, mobile television in its Chrysler, Jeep, and Dodge car and Ram truck vehicles, with up to 20 channels featuring college and professional sports, breaking news, children's entertainment, primetime network shows, reality TV, and daytime dramas.

A year later, the 2010 Chrysler Sebring (replaced with the Chrysler 200 in 2011) and Dodge Avenger models introduced several new smart accident-avoidance features, including responsive steering, brake assist and anti-lock brakes, and electronic stability control with all-speed electronic traction control. Other smart amenities were an enhanced accident response system, remote keyless entry and remote start, and tire pressure monitoring.

Today's Avenger now affords ambient interior lighting and the new Dodge steering wheel with integrated controls that allows drivers to operate the radio, cruise control, hands-free phone communications, and other vehicle functions without taking their hands off the wheel. Drivers also can stay connected via an available media center with voice command that is easy to use, featuring SIRIUS Satellite Radio, a 30-gigabyte hard drive, iPod connectivity, streaming music capability, and a navigation system.

Smart safety innovations still remain the mainstay for most vehicle consumers, though. When the newly designed 2011 Dodge Charger was unveiled, more than 65 enhanced security and safety features were touted. The most popular were electronic stability control with segment-exclusive ready-alert braking and rain brake support, both aimed at improving overall vehicle handling and performance, in addition to adaptive cruise control with forward collision warning, blind spot monitoring with rear cross-path detection, and a ParkView rear backup camera with grid lines.

October 2011

How Industry Accountability Practices Can Restore Public Trust, Confidence

By Steven J. Storts
Dublin, Ohio

MAJOR industries have been engulfed in several critical events this past year—an oil rig explosion and ensuing spill, mine cave-ins, a utility pipeline explosion, and multiple environmental investigations—all raising issues of safety and quality. For the engineering community, these issues pose a more diverse challenge: how to regain public confidence in the products and services provided by industry.

Restoring public trust can often be evasive. Determining fault or liability for any industrial incident is certainly the first step, but that is usually an action reserved for the legal system; accountability, on the other hand, is a decision the public renders, one that invites industry at large to provide some assurance that similar incidents will not occur in the future.

So, how can credibility be restored? It begins with a set of principles that point toward measures of accountability. For professional engineers employed in industry, accountability has always been a long-sought-after goal. Repeal of the engineering licensure exemption has been legislatively lobbied for decades at the state level, but tendering an across-the-board repeal is probably only a distant possibility. What is proving more practical is convincing young engineers of the long-term value in pursuing licensure by laying out the tangible career benefits of professional credentials: better compensation, expanded opportunities for management roles, wider selection of technical assignments, and the option to practice in other engineering fields such as consulting.

Still, individual accountability is only part of the equation. And it is not just a matter of licensure or removing the industry exemption; it is doing the right thing and making the right decisions. Individuals within private industry do not have the option of setting their own standards, although many companies are developing mechanisms for some type of internal peer review. Instead, accountability must be achieved on a wider scale that encompasses all business operations.

Industry leaders might do well to take a page out of the playbook of the Coalition for Environmentally Responsible Economies, an advocacy network of investors and environmental groups. Years ago, CERES promulgated a set of challenges that are now serving as a model for accountability among numerous global enterprises. Aimed at helping industries incorporate environmental stewardship into their business culture, these challenges include: protection of the biosphere, sustainable use of natural resources, reduction and disposal of wastes, energy conservation, risk reduction, safe products and services, environmental restoration, informing the public, management commitment, and audits and reports.

Full accountability, however, does not end with environmental advocacy; it is just the beginning. Accountability must be self-imposed. For instance, in the aftermath of the BP oil spill, major energy companies are beginning to disclose information regarding their risk oversight measures for their offshore oil operations around the world. Transparency has come to the forefront because investors (the public) are now focusing attention on the necessary governance, compliance, and management systems for minimizing risks associated with industrial operations.

Environmental sustainability and transparency of business practices, however, are only two elements of self-imposed accountability. Other factors include risk management, the economic and social impacts of business operations, and corporate governance and ethics. Of those remaining factors, risk management assumes a dominant role for the industrial engineering community.

With risk inherent in any venture, particularly where human decision-making is a major consideration, many industries have turned their attention more toward *risk assessment*, a process that scrutinizes policies and procedures from every perspective to limit the possibility for any business operation, product, or service to endanger the public or environment.

Those advocating this process contend that accountability will improve when risk assessment becomes part of the business culture itself. But that culture will require bringing every possibility for imminent danger to the forefront, thereby erasing the stigma of whistle-blowing from any level of employment.

For industry there are many simple tools at hand for engaging in risk assessment:

- Conducting brainstorming sessions that consider all scenarios of potential threat;
- Doing more in-depth research from a socio-economic perspective prior to actual industrial design;
- Scrutinizing safety and environmental regulations more closely; and
- Improving inspection training.

Industry risk assessment is also expanding use of information technology, 3-D modeling, and various *imagineering* techniques, whereby computer modeling "imagines" countless scenarios that pose an imminent threat to public or environmental safety. Part of this process also involves "designing for failure," with failure meaning the unforeseen, accidents, or mechanical breakdown. This technique not only targets the *unexpected* in the actual use of a product or service, but it also addresses one of the many principles espoused by the late W. Edwards Deming, founder of the original Total Quality Movement—eliminating defects in the industrial production process, primarily through statistical analyses and reduction of human error.

Automotive, farm machinery, power tool, landscape equipment, and aircraft manufacturers are examples of industries using these risk assessment tools to help eliminate or reduce the possibility for human error before, during, and after the production process. By striving to limit any dire consequences due to human error, these industries are strengthening their accountability practices before the eyes of the public.

November 2010

Corporate Sustainability Practices Vary in Creativity, Use, Savings

By Steven J. Storts
Dublin, Ohio

FOR many leading U.S. industries, *sustainability* is not just a buzzword or a means for improving their public image. It is an environmental practice that is steadily becoming part of the business culture, woven into the corporate fabric of planning, development, and production operations.

Although generally associated with the green movement, sustainability exceeds the basic tenets of environmental stewardship through engineering application of diverse technologies that improve energy efficiency, indoor environments, industrial processes, waste management, and more.

Where product delivery is the target, sustainability is accomplished through a lifecycle assessment approach that considers all stages of a product's life — from raw material acquisition to manufacturing, transportation, installation and use, and, ultimately, to recycling and waste reduction.

Organizations are beginning to chart the progress made in moving forward their sustainability programs, now that benchmarks are in place. Recently, the chief executive officers of nearly 100 companies shared their best practices and success metrics in sustainability with The Business Roundtable, which compiled the data into an annual report entitled *Enhancing Our Commitment to a Sustainable Future 2010.*

Roundtable member companies represent virtually every sector of the economy, with nearly $6 trillion in annual revenues and more than 12 million employees. Here are just a few examples of their sustainability practices in which engineering is playing a significant role:

- **Boeing:** Since 2002 on a revenue-adjusted basis, the company has reduced carbon emissions by 31 percent, trimmed energy consumption by almost one-third, and cut hazardous waste generation by 38 percent.
- **Coca-Cola:** In 2009, the world's largest bottle-to-bottle recycling plant was opened, which will produce about 100 million pounds of food-grade recycled polyethylene terephthalate plastic annually.
- **Cummins:** All new engines are being designed to run on a 20 percent blend of biodiesel fuel, and more than 50 million pounds of engine-related material are recycled and reused annually.
- **Flordia Power & Light:** In 2009, the largest solar photovoltaic power plant in the U.S. was commissioned, and two other commercial-scale solar energy centers are planned.
- **General Mills:** A biomass energy project is underway that will generate steam from burning leftover oat hulls from producing Cheerios to heat and power the company's oat milling facility near Minneapolis.
- **Pepsico:** Gatorade bottles are being cleaned with purified air instead of rinsing with water, a process that is expanding to bottling plants worldwide, saving valuable resources.
- **Weyerhauser:** In a joint venture with Chevron, biomass energy produced from managed forests is being converted into liquid fuels for transportation use.
- **Whirlpool:** A front-loading washer was introduced in 2009 that can save consumers more than $1,000 in water and energy over the lifetime of the product, and more than 85 percent of the materials used in its production can be recycled.

Outside of the Roundtable circle, other businesses, too, are leading the way in sustainability practices, including:

- **Ford:** Introduced into the vehicle lineup in 2009, the new EcoBoost engine uses a combination of turbocharging and direct injection to deliver up to 20 percent better fuel economy without sacrificing performance and significantly reduces carbon emissions. By 2013, EcoBoost will be available on 90 percent of the product nameplates, from small cars to large trucks.
- **Hawaii Electric Light:** In addition to instilling use of a 20 percent blend of biodiesel fuel in its fleet vehicles, and eventually adding electric vehicles to the pool, the company has set a target year of 2030 to generate at least 40 percent of its energy production from sustainable resources.
- **Hewlett-Packard:** Energy consumption of HP's highest-volume desktop and notebook PCs has been reduced by 41 percent since 2005, and the 2008 goal of trimming energy consumption another 25 percent by 2010 using the 2005 baseline has already been exceeded. The new goal is to reduce the energy consumption and associated greenhouse gas emissions of all products to 40 percent below 2005 levels by the end of 2011.
- **U.S. Steel:** Waste generation and emissions are being reduced by using a gas byproduct produced in the blast furnaces and coke ovens in the place of natural gas, while water used during production is processed and reused in the form of steam to generate electricity.

As the focus on sustainability initiatives continues to widen, engineering innovation and creativity will be key in developing new practices for environ-

mental stewardship as well as honing environmentally responsible technologies that have already proven successful. Engineers will, in fact, become the new pioneers for identifying and authoring sustainable solutions for the challenges posed by future domestic and global economies.

May 2010

More Companies Taking Stance On Curbing Bribery, Corruption

By Steven J. Storts
Dublin, Ohio

MORE than 60 companies worldwide have now committed to the World Economic Forum's initiative to ban influence peddling and eliminate bribery in corporate transactions.

Introduced at WEF's meeting in Davos, Switzerland, in January, the Partnering Against Corruption Initiative has enlisted the support of several U.S. engineering, construction, and industrial corporations, including CH2M Hill Companies Ltd., Fluor Corp. Bechtel Group Inc., Turner Construction International L.L.C., Cinergy Corp. Ltd., Newmont Mining Corp., and Occidental Petroleum Corp.

The most recent PACI advocate, Washington Group International Inc., provides integrated engineering, construction, and management services worldwide. "The PACI principles are consistent with our company's established compliance program and will be used to benchmark and improve existing policy," says Stephen Hanks, Washington Group's president and CEO.

"An anticorruption policy will continue to be an integral part of ongoing employee training," Hanks adds. "It is critical that every Washington Group employee strictly adheres to these principles."

The PACI Principles for Countering Bribery, derived from Berlin-based Transparency International's Business Principles for Countering Bribery, call for a commitment to two fundamental actions: a zero-tolerance policy on bribery and the development of a practical and an effective implementation program to curb bribery practices.

"We believe that the widespread adoption of the PACI principles will raise business standards across the globe and contribute to the goals of good governance and economic development," Hanks notes.

Corporate officials from WEF's engineering and industrial communities have been addressing the problem of corruption and bribery since 2002. In the U.S., federal lawmakers passed the Sarbanes-Oxley Act, requiring top company executives and financial officers to personally certify that their internal audit procedures are ethical and sound. As a similar benchmark, PACI encourages companies to establish internal programs to provide education and oversight for company executives.

"We would say that companies that are committed to very high standards will, nevertheless, from time to time have failures," says Jermyn Brooks of Transparency International, pointing out that large companies can find it very difficult to continually be in control of all of their employees. "The question is how do they react to it?" he asks. "How do they respond themselves?"

With the number of large multinational companies doing business worldwide on the increase, Brooks contends that peer pressure will contribute to more companies committing to PACI principles.

However, one of the pact's signatories emphasizes that just because a corporation hasn't signed on doesn't indicate its lack of commitment to the same principles. "The fact that some companies aren't on the list doesn't mean they don't have active programs to combat the problem," notes Alan Boeckmann, chief executive officer of Fluor Corp.

Still, the PACI Board of Directors has engaged in a campaign to attract more companies from all business sectors to join in partnering against corruption by participating in the initiative. The initiative aims to turn its principles into a tangible instrument, while providing a neutral platform for companies to consolidate their efforts to counter bribery and corruption.

"The overwhelming positive response to PACI demonstrates both the desire and urgency of addressing this issue," says Klaus Schwab, WEF executive chairman. "The commitment of the signatory companies marks a significant step toward tackling corruption and bribery from a corporate perspective."

The initiative already has one key achievement to its credit. Based on the PACI Engineering and Construction Task Force, in cooperation with Transparency International, the World Bank has agreed to include antibribery language as part of the bidding process for infrastructure projects financed by the World Bank. A similar approach is also being pursued with the Asian Development Bank and the Japanese Development Bank.

May 2005

White House Promotes Strategy for Bolstering Manufacturing Recovery

By Steven J. Storts
Dublin, Ohio

AT a January business roundtable in Cleveland, Ohio, the Bush administration outlined recommendations from its recently released report on U.S. manufacturing, addressing the challenges faced by the recovering industry sector in regaining its competitive edge, expanding business, and creating new jobs to help both the overall domestic economy.

The White House report *Manufacturing in America: A Comprehensive Strategy to Address the Challenges to U.S. Manufacturers* was unveiled to Cleveland area manufacturers by U.S. Commerce Secretary Donald Evans. "President Bush is dedicated to growing the Ohio manufacturing industry and creating new jobs," Evans noted. "This is our strategy to remove the bar-riers that are holding back American manufacturers and costing jobs." The administration official said the report is one step in an ongoing process to help ensure that American companies are competitive in every part of the world.

During the roundtable, Evans announced that Grant Aldonas, under secretary for the International Trade Administration, would serve in an interim capacity as point person for manufacturers until Congress passes the legislation to create and fund a new position of assistant secretary of commerce for manufacturing and services, one of the recommendations listed in the administration's report.

"The Bush administration has broken new ground acknowledging that manufacturing is vital to the nation's economy, recognizing the unique challenges to our global leadership, and recommending reforms to strengthen our manufacturing competitiveness," says Jerry Jasinowski, president of the National Association of Manufacturers (NAM).

Manufacturing in America includes input from more than 20 manufacturing public roundtables held last year by the Commerce Department to identify the challenges facing U.S. manufacturers. The roundtables included small, medium-size, and large companies from a broad range of industries, including auto parts, aerospace, biotechnology, and semiconductors.

The culmination of those forums is a series of policy recommendations aimed at helping ensure that government is doing all it can to create business conditions that will allow companies to maximize their competitiveness and spur economic growth.

In addition to creating a new commerce post for manufacturing, the report includes provisions that would:

- Establish the President's Manufacturing Council to help the federal government implement the recommendations in the manufacturing report;
- Establish the Office of Industry Analysis to gather the right data to help government understand the impact of its decisions on the manufacturing sector's ability to compete;
- Call on the U.S. Treasury Department to lead a tax simplification study—addressing depreciation and the corporate alternative minimum tax—focused on lowering compliance costs for manufacturers;
- Improve the coordination of more than $15 billion in economic development programs to help address the economic challenges facing distressed communities that have manufacturing-dependent economies; and
- Request the Office of Management and Budget to lead a comprehensive regulatory review, assisted by the Office of Industry Analysis, to inventory all existing regulations, evaluate proposed reforms, and then implement those reforms on a priority basis.

"This is the first time in modern history that an administration has made manufacturing in America a top national priority," Jasinowski points out. "This report should be seen as a first step, and we strongly welcome it. What we need to do now is convert the report into real world action."

The NAM president says his organization will seek an early emphasis on dealing with two of the principal issues raised by small and medium-sized manufacturers—the special challenge of China and expanding and improving the federal government's Manufacturing Extension Partnership program.

"This report is the beginning of a process, not the end," notes Jasinowski. "NAM will continue working on behalf of all manufacturers . . . as we pursue policies that will help keep American manufacturing ahead of the global curve. We have the best workers in the world, and when they're given a fair chance to compete, there's little doubt they'll succeed."

March 2004

Feds Address Security of Defense Industry

By Steven J. Storts
Dublin, Ohio

WHILE much of today's homeland security news is focusing on the prevention of terrorism on U.S. soil, law enforcement agencies are also addressing other threats, those within the defense industry such as illegal exporting of military technology and theft of trade secrets.

Last year, agents from the Defense Criminal Investigative Service and the Bureau of Immigration and Customs Enforcement executed search warrants on 18 companies in 10 states as part of an ongoing investigation regarding illegal transfer of military components in violation of the Arms Export Control Act.

DCIS agents, working with U.S. Department of Homeland Security's ICE agents, launched a multistate execution of search warrants in Colorado, Florida, Kansas, Louisiana, New Hampshire, New York, Oregon, South Carolina, Texas, and Wisconsin. Additionally, DCIS and ICE agents served a total of eight subpoenas and conducted one "consent search."

Each of the firms is suspected of exporting military technology on the U.S. Munitions List without obtaining the appropriate license from the U.S. Department of State. Among the military technology allegedly included in the exports were components for the F-4 Phantom, F-5 Tiger, and F-14 Tomcat aircraft, and the Hawk Missile System. The companies allegedly shipped these components to a London-based company, Multicore, Ltd., which also operates under the name AKS Industries. U.S. authorities earlier found that Multicore London has ties to the Iranian military.

In June 2001, DCIS and ICE agents (then known as U.S. Customs agents) arrested two Multicore officials, Saeed Homayouni and Yew Leng Fung, both of Bakersfield, California, who then entered plea agreements in federal district court. Homayouni pleaded guilty to one count of conspiracy to violate the Arms Export Control Act and the International Emergency Economic Powers Act, and Fung pleaded guilty to one count of misprision of a felony.

The Multicore investigation determined that Homayouni and Yew purchased sensitive military technology from vendors in the U.S. The parts were shipped to Bakersfield where they remained in private storage units until shipped out of the country to Singapore without the required export licenses and using a fictitious business entity. The parts were then transshipped from Singapore to Iran.

In August 2002, British authorities provided DCIS and ICE with evidence disclosing that a multitude of U.S. companies conducted business transactions with Multicore London, even after the federal agents raided Multicore's Bakersfield facilities. DCIS and ICE then launched investigations into U.S. companies doing business with Multicore London, leading to the recent execution of the warrants.

Another ongoing joint investigation, conducted between DCIS and the Air Force Office of Special Investigations (OSI), resulted in a criminal indictment last July against two former Boeing Co. managers. The two employees, involved in the Evolved Expendable Launch Vehicle (EELV) program, were charged with conspiracy to conceal and possess trade secrets by a federal district court grand jury in Los Angeles.

The grand jury returned the criminal indictment against former Boeing managers Kenneth Branch, 64, and William Erskine, 43, for the misuse of proprietary Lockheed Martin Co. documents during bidding for Air Force launch contracts. If convicted, both men face a maximum of 10 years confinement and a fine of $250,000, or both.

"The potential theft of proprietary data is a specter that can strike at the very foundation of any competitive system designed to ensure quality while containing costs," says Joseph Schmitz, inspector general for the U.S. Department of Defense. "Competitions to design and build the most advanced military systems in the world for DOD have a potential value of billions of dollars per year. Part of the mission of DCIS special agents is to investigate allegations to ensure that the integrity of commercial competitions are strictly maintained and that a fair playing field is maintained among contractors."

In 1997, the U.S. Air Force announced contracts for EELV services to both Boeing and Lockheed Martin. The Air Force agreed to provide each company with $500 million for development costs associated with their respective EELV programs, with both companies agreeing to pay any additional developmental costs. A year later, of the 28 initial EELV launches, Boeing won 19 of the those launches, while Lockheed won nine. The EELV program uses the Lockheed Atlas or the Boeing Delta rocket systems to launch government satellites into space for national security interests and to transport commercial satellites.

Upon learning about the loss of proprietary documents in 2002, Lockheed Martin alerted the Air Force, which, in turn, informed federal authorities. DCIS and OSI then launched an investigation into the theft and referred the case to U.S. Attorney Debra Yang for the Central District of California.

Industry, Government Partners Unveil Plan to Road Test Fuel Cell Vehicles

By Steven J. Storts
Dublin, Ohio

SENIOR officials from Daimler Chrysler, UPS, and the U.S. Environmental Protection Agency have announced their collaboration on the first major demonstration project to test hydrogen-powered fuel cell vehicles for commercial use. The initiative was unveiled in May at EPA's National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan.

The fuel cell test program, which will be based at NVFEL, will be the first time under actual road conditions that zero-emission, medium-duty fuel cell delivery vehicles are introduced as a part of a commercial delivery fleet in the U.S. The DaimlerChrysler fuel cell vehicles will be used in typical UPS delivery operations on established routes, enabling EPA and the partnering companies to continue evaluating fuel cell vehicle attributes such as fuel economy and driving performance under varying weather conditions.

"DaimlerChrysler is working on various fronts in order to bring fuel cell vehicles onto public highways," says Dieter Zetsche, a member of the company's management board and president and CEO of the Chrysler Group. "We welcome the chance to cooperate closely with EPA and the U.S. Department of Energy on this project in order to more quickly bring President Bush's vision of a hydrogen-driven vehicle to life by presenting tangible advances."

The deployment of the zero-emission vehicles, in two different sizes, will begin later this year and continue in 2004. First, the project will commence with a passenger-sized express-delivery test vehicle, a Mercedes-Benz A-Class equipped with a Ballard fuel cell drive. It will then be joined by one or more fuel cell-powered Dodge Sprinter vans, whose standard fuel-efficient diesel engines are already certified as ultra-low-emission systems under EPA guidelines. Currently, there are 2,500 Sprinter vehicles in UPS's domestic and international fleets.

The new hydrogen-powered fuel cell vehicles will join an already large number of alternative-fuel vehicles in the UPS fleet. The company now operates 1,024 compressed natural gas vehicles in the U.S., the largest private fleet in the nation. In addition, UPS uses more than 800 propane-powered vehicles in Canada and Mexico City; liquefied natural gas tractors in its West Coast fleet; and an assortment of all-electric vehicles in its operating facilities. The company began testing hybrid electric technology in 1998 and made history in 2001 by introducing the industry's first hybrid electric vehicle into its operations.

Fuel cell technology is the latest innovation in UPS's commitment to develop sustainable transport options. The company is working to develop future generations of delivery vehicles that reduce dependence on fossil fuels, significantly reduce fuel consumption, and create a vehicle platform to bridge to the hydrogen economy.

"It's time to deploy this technology in a commercial fleet and learn exactly what's needed to make it broadly available," notes Tom Weidemeyer, president of UPS Airlines and chief operating officer. "These vehicles are going to be rolling laboratories. Environmental improvements like this and the needs of business are not incompatible."

The Ann Arbor lab will provide a state-of-the-art hydrogen fueling station—designed and built by Air Products and Chemicals Inc., of Allentown, Pennsylvania—to serve Southeast Michigan in providing compressed hydrogen fuel for the UPS vehicles and other fuel cell cars in the area. NVFEL is the only federal facility able to test fuel cell vehicles for fuel economy and emissions. As part of EPA's Office of Transportation and Air Quality, the facility is responsible for carrying out laws to control air pollution from motor vehicles, engines, and their fuels.

EPA, having developed the first testing protocols and modified the lab to handle hydrogen fuel safely, successfully completed the first official certification test of a fuel cell vehicle. The agency expects NVFEL to be critical to the evaluation of current and future generations of hydrogen-fueled vehicles, in addition to the certification of vehicles for sale or lease.

July 2003

Manufacturers Welcome Study on Bolstering U.S. Global Competitiveness

By Steven J. Storts
Dublin, Ohio

NATIONAL Manufacturing Week in early March was greeted with the announcement of a federal initiative to examine factors affecting the global competitiveness of U.S. businesses and recommend ways government can improve business conditions for a lagging industrial sector.

Addressing an audience of small and large manufacturers in Chicago, March 5, U.S. Commerce Secretary Don Evans said America's manufacturing sector and its economy are as resilient as its people, noting that there are hopeful signs on the economy's manufacturing front. "Business investment has started to climb," he reports. "New orders for manufactured goods have started to rise again. Those signs reflect the single most important factor of our economic strength—the rising productivity of U.S. workers."

Evans cites a rise in productivity rose by nearly 4% over the last four quarters, the highest rate in 10 years. That performance figure led the World Economic Forum this past November to name the U.S. as the most competitive economy in the world, he adds.

Still, Evans says there's much more work to do. "The economy, particularly in the manufacturing sector, is not creating jobs at anywhere near the rate any of us would like to see," he observes. "That is why the president and I are focused on manufacturing. The manufacturing sector represents the best of what American business is about."

The commerce secretary emphasizes that the Bush administration has set a goal by mid-summer to identify the challenges facing U.S. businesses and outline a strategy for ensuring that the government is doing all it can to create the conditions that will allow manufacturers to maximize their competitiveness and spur economic growth.

"You have asked that we lower the tax burden on U.S. manufacturing and lower the cost of research and development, and we have delivered," Evans points out. "The president not only produced a sharp cut in tax rates in 2001, but asked Congress to accelerate the remainder of those cuts to stimulate business investment.

"You asked that we reduce the taxation of dividends, and the president responded by asking Congress to eliminate the double-taxation of corporate income, which will free an estimated $20 billion for our economy and make business investment a far more attractive proposition." In fact, The Business Roundtable estimates that the dividend proposal will create as many as 500,000 new jobs annually over the next five years, with many of those in manufacturing.

In response to Evans' remarks, Jerry Jasinowski, president of the National Association of Manufacturers, says the administration "clearly understands the critical need to increase the competitive strength of America's manufacturing sector and create jobs throughout the economy. We welcome their support of manufacturing and the initiative to undertake a comprehensive review of the issues influencing the long-term competitiveness of the U.S."

Evans cites other issues that are impacting the manufacturing sector, including depreciation, trade tariffs, and intellectual property protection. Emphasizing that 80% or more of NAM's members are small manufacturers, the commerce secretary notes that the president also asked Congress to increase the amount of money businesses can deduct for investment in new equipment—by tripling the expensing allowance to $75,000 beginning this year.

What holds true for taxes also holds true on other parts of the manufacturing agenda, Evans explains. "Take trade, for example," he says. "You asked that we use the authority . . . fought for under trade promotion authority to open new markets to American manufacturing and eliminate unfair trade practices. The administration responded by proposing that World Trade Organization members eliminate all industrial tariffs within 10 years."

In addition, Evans says the administration has an active agenda of bilateral free-trade-area negotiations underway to accelerate the elimination of barriers to U.S. manufacturing exports wherever possible.

Stronger intellectual property protection and funding for federal science programs also rank high as priorities for the administration, which has redoubled its efforts to eliminate piracy of intellectual property abroad and streamline and improve the quality of the patenting and trademarking processes in the U.S. Research and development funding has been increased, too, by more than 25%, Evans notes.

"What the U.S. economy needs right now is a solid focus on economic growth, which is essential to overcoming many of the problems facing manufacturing and other sectors of the

economy. The best way to achieve that growth is for Congress to promptly enact the president's tax measures to improve investor confidence, increase consumer spending and boost capital investment," Jasinowski concludes.

May 2003

Corn-to-Plastic Production Becomes Reality in a Small Nebraska Town

By Steven J. Storts
Dublin, Ohio

A CHEMICAL plant that is nestled in what used to be a Nebraska cornfield recently opened its doors for business. But, it's not just any chemical plant. It's the first global-scale manufacturing facility capable of making commercial-grade plastic resins from annually renewable resources such as ordinary field corn.

The grand opening of the Minnesota-based Cargill Dow L.L.C., facility represents a shift to a future where the raw material—the carbon source—is derived from annually renewable resources, instead of the limited fossil resources used to make most conventional plastics today. Located just outside of Omaha on 16 acres of Missouri River bottomland in the small town of Blair, the new plant is the culmination of nearly $750 million of investment in research and development.

With its new technology, Cargill Dow has the capacity to produce up to 300 million pounds (140,000 metric tons) annually of polylactide polymer, a polymer resin that is derived from natural plant sugars. About 40,000 bushels of locally grown corn per day serve as the primary raw material used in the manufacturing process.

Recognized by the Federal Trade Commission as a generic class of fiber—like cotton, silk, and polyester—PLA can be used in making clothing, carpets, bedding, packaging and other products. PLA, the first polymer derived entirely from a renewable resource, is also fully compostable at the end of its product life.

Briefly explained, the Blair facility harvests the carbon naturally stored in simple plant sugars resulting from photosynthesis. Through a process of simple fermentation and distillation, Cargill Dow is able to extract the carbon and use it as the basic building block for commercial grade plastics and fibers.

The company's breakthrough products, including NatureWorks PLA and NatureWorks fibers, will be shipped around the world for use in an array of consumer items, and in essence, competing head-to-head with traditional petroleum-based plastics.

From the corn planter to the retail counter, NatureWorks PLA has a lifecycle that reduces fossil fuel consumption up to 50%. In addition, the process to make the product generates 15% to 60% less greenhouse gases than the material it replaces. Research also shows that technology advancements in PLA could allow from 80% to 100% reduction in greenhouse gases.

"The benefits of items made from NatureWorks PLA are already being experienced by many consumers around the globe," says Randy Howard, president and chief executive officer of Cargill Dow. "Companies like the Coca-Cola Company, Dunlop Pacific, Sony Pacific, Pacific Coast Feather Company, and Monogram are already realizing significant value based on the resulting products' performance and unique story."

Founded in 1997, in Minnetonka, Minnesota, Cargill Dow and its PLA technology developed in part with support from the National Institute of Standards and Technology's Advanced Technology Program. The co-funded research led to enabling processing methods that helped PLAs gain important new properties without losing the environmentally friendly traits that made them attractive in the first place. Last year, PLA development received environmental innovation awards from the magazines *Discover, Popular Mechanics* and *Industry Week*.

Over the next few years, Cargill Dow will be spending about $250 million on commercial development, product technology development, and advanced applications research to enable the conversion of biomass to PLAs.

"What's really exciting is not just the science and technology," Howard observes, "but the scope and magnitude of what we are doing. The size and scope of our manufacturing facility are as large as, if not larger than, traditional thermoplastics facilities. We are not a niche player. We are global. We are a reality, and we are here to stay."

June 2002

U.S. Steel Develops Strategy to Restore Needed Vitality to Domestic Industry

By Steven J. Storts
Dublin, Ohio

THE United States Steel Corporation announced that it is developing a plan for significant consolidation in the domestic integrated steel industry, deciding not to wait for Congress, the White House, or the International Trade Commission to come to its economic rescue.

"U. S. Steel believes that consolidation of the industry under the right circumstances will be a positive step toward restoring the health of this vital part of the American economy," notes Thomas Usher, board chairman, president, and CEO. "We are willing to participate in such a process, but only to the extent that it is beneficial to U. S. Steel's customers, shareholders, creditors, and employees."

Usher also points out that U. S. Steel is a strong enterprise with the flexibility and resources to continue to pursue its business strategy while considering such consolidation opportunities.

Consistent with its goal of consolidation, the Pittsburgh-based company is holding talks with NKK Corporation of Japan and the National Steel Corporation concerning a possible acquisition of National Steel. Company officials emphasize, however, that any acquisition would be contingent on a number of significant conditions, including a substantial restructuring of National Steel's debt and other obligations.

U.S. Steel's latest business enterprise comes at a time when congressional members are asking President Bush to provide immediate relief to a beleaguered steel industry. In fact, the Emergency Steel Loan Guarantee Board has already received a congressional request to quickly approve a $250 million loan guarantee for the Cleveland-based LTV Steel Company Inc.

According to Rep. Ralph Regula (R-Ohio), the loan guarantee would allow two Cleveland banks to release the necessary funds to keep LTV in the steelmaking business, saving thousands of jobs in addition to the health care benefits of 60,000 company retirees.

Perhaps more significantly, bipartisan congressional steel caucuses are urging the White House to enact steel tariffs of 20% on imports of 12 products into the U.S., as recommended in December by three members of the International Trade Commission, including its chairman.

ITC's determinations, which now confirm the adverse impact of subsidized foreign imports on American steel producers, account for 27 million tons of steel imported into the U.S. in 2000, valued at $10.7 billion. The ITC forwarded its recommendations to the White House, which has 60 days to act on them.

"The industry welcomes the ITC's recognition that tariff-based remedies are necessary at this time," says Usher. "However, in these market conditions, 20% tariffs are inadequate to redress the serious injury caused by foreign imports. We urge the president to act quickly to adopt 40% tariffs on all flat-rolled imports, including slabs. That is the only remedy that will give America's steel industry the chance to restructure and recover from years of excessive low-priced imports."

Slab production is the first step for all flat-rolled steel production, and it is where most of the capital investment and innovation occurs, U.S. Steel's board chairman explains. "To be effective, relief must cover all the major steel product lines," Usher emphasizes. "Granting relief on some products but not others will simply encourage the shifting of foreign capacity to the products exempted from import relief, without significantly reducing the excess capacity that is the cause of the current crisis."

Imposition of a fully effective trade remedy is essential to the Bush administration's steel program announced last June, according to Usher and other steel industry executives. The president outlined a comprehensive three-part strategy to address the excessive imports of steel that have been depressing markets in the U.S. The recent ITC investigation is one element of his steel program. The other two parts of the plan are multilateral negotiations to address foreign overcapacity and the continued aggressive pursuit of foreign anticompetitive practices, such as subsidization and closed markets.

Usher admits that for his company's consolidation plan to be successful, the participation of the federal government, the United Steelworkers of America, and domestic steel companies will be required. U.S. Steel's plan involves several key elements.

First, it requires the implementation of the president's three-part strategy, a critical part of which is a strong remedy under Section 201 of the Trade Act of 1974. Next, it calls for the creation of a government-sponsored program that would provide relief from retirement cost burdens—primarily pension and retiree health care costs—thereby removing the most significant

barrier to consolidation of a highly fragmented industry. Finally, the plan requires a progressive labor agreement that would provide for meaningful reductions in operating costs.

In addition to negotiations with foreign governments to establish rules governing steel trade and eliminating subsidies, Usher says President Bush's program includes import relief under Section 201, plus further foreign negotiations to seek near-term elimination of inefficient, excess steel production capacity throughout the world.

February 2002

Manufacturing Technology Study Shows Growing Consumer, Economic Benefits

By Steven J. Storts
Dublin, Ohio

TRADITIONAL economic measures of productivity alone do not reveal the full extent of contributions by advanced manufacturing technologies to the nation's economic progress, according to a study released by the Association for Manufacturing Technology.

AMT reports that over the past five years, those benefits have amounted to nearly $1 trillion. "Machine tools and technologies, other than computers and microprocessors, receive inadequate credit for America's prosperity," says the study's author, Joel Popkin of Joel Popkin and Company, Washington, D.C.-based economic consultants.

Recent research concludes that contributions of enhanced productivity in traditional manufacturing equaled—and may have exceeded—those of the high-tech sectors, including computers and information technologies.

The study, *Producing Prosperity: Manufacturing Technology's Unmeasured Role in Economic Expansion*, goes further in explaining why the remarkable growth in durable goods-producing industries, with a rate of increase in real output between 1992 and 1997 about twice the rate of the overall economy, is not the full measure of the benefits associated with advanced manufacturing technologies.

The AMT study also reveals that between 1959 and 1996, manufacturing productivity grew about 40% faster than productivity in the overall nonfarm economy as measured by multifactor productivity, a fundamental measure that considers factors beyond capital and labor. Between 1992 and 1996, durable goods manufacturing (such as autos, appliances, and aircraft) achieved MFP gains averaging 4.2% annually.

"For the last several years, a puzzling gap has existed between what traditional economics was telling us about productivity and what the economy has actually done," notes AMT President Don Carlson. "This study allows us to see the light. Moreover, because it is focused on only the manufacturing technology industry, this study may well be only the tip of the iceberg. It is likely that other manufacturing industries have a similar tale to tell."

AMT cites some major benefits from productivity gains in manufacturing:

- Eight key industries saved a combined total of $24.3 billion in payroll costs in 1997 alone—and $80 billion between 1992 and 1997—because of productivity increases. They include auto parts, aircraft engines and parts, engines and turbines, metal foundries, fabricated structural metal, other industrial machinery, construction and mining equipment, and farm and garden machinery.
- The cost of consumer durable goods from 1996 to 1999 was about $100 billion less than it would have been without the productivity gains and purchases of imports.
- Consumers are saving billions in costs from product quality improvements such as cars with higher fuel efficiency ($50 billion in 1999).

"The study proves that much of the gain in productivity reflects a revolution in manufacturing technology generally and advances in machine tools specifically," says Carlson. "Manufacturers operate today in a complex, competitive, quality-conscious world where the consumer's demand for mass customization has replaced the earlier one-style/color-fits-all notion of mass production."

AMT points out that this intense competition has led to advances in production automation and product quality. In the aerospace industry, for example, the McDonnell Douglas Corporation took advantage of high-speed machining—operating 15 times faster than with a previous method—to improve the manufacturing process for landing-gear bulkheads on the C-17 aircraft. With the new process, it makes bulkheads with two parts rather than 72, secured by 35 fasteners instead of the previous 1,720.

Quality improvements are especially dramatic in the automobile industry, the association emphasizes. Citing an annual average quality improvement rate of 2.2% documented by the U.S. Bureau of Labor Statistics between 1967 and 1998, the study notes that today's car has twice the quality of one built 30 years ago in terms of performance, reliability, durability, and warranty. As a result, an owner of a new car produced today by U.S. companies experiences fewer than 30 problems per 100 vehicles during the first year of ownership as compared with a rate of 104 problems per 100 cars in 1980.

That higher quality translates into significant consumer savings as a result of fewer repairs and longer useful life, AMT explains, adding that car maintenance costs dropped 28% between 1985 and 1998, saving consumers $21 billion in 1998 alone.

Largely due to machine tool advances that have streamlined produc-

tion, consumers are realizing similar savings with other durable goods, too, the study reports. The scroll compressor, for example, made possible by more precise and flexible machine tools, contributed to a 40% increase in the energy efficiency ratings of air conditioners and heat pumps since 1981, while refrigerators realized a 100% improvement. As a result, in 1997 alone, consumers saved nearly $20 billion in electricity costs.

February 2001

Support for Ergonomics Assumes More Voluntary Approach from Industry

By Steven J. Storts
Dublin, Ohio

THE recent nullification of the federal ergonomics standard promulgated by the Occupational Safety and Health Administration has opened the door for new debate on the issue of repetitive-stress injuries and musculoskeletal disorders in the workplace.

In a letter to U.S. Secretary of Labor Elaine Chao, the American Industrial Hygiene Association urged "all sides to move forward with a comprehensive approach to solving the ergonomics problems of America's workers," emphasizing that OSHA and other organizations have shown strong evidence supporting the need for an ergonomics standard.

AIHA President Steven Levine encouraged the labor secretary to take a leadership position in finding a new approach to an ergonomics standard, but with serious consideration to "the need for new rulemaking that involves all stakeholders in the process, not just those representing industry and labor." He cited AIHA's contention that substantial savings accrue to employees when effective ergonomics programs are in place.

Though most of the publicity relating to ergonomics has targeted proposed federal requirements, some state jurisdictions are moving forward with their own guidelines regarding workplace safety issues.

The *Wall Street Journal* reports that almost 24 states operate their own workplace safety programs under OSHA supervision and were forced to speed up ergonomic requirements to meet the anticipated federal policy. With the federal standard rescinded, those states now have the option to approach ergonomics safety at their own pace and according to their own guidelines.

For example, California is still pressing ahead to try to enact OSHA's finalized standard, which would have been more stringent than the state's policy. The OSHA standard called for workers to take action after one injury, whereas California requires action only after similar injuries afflict two employees doing the same job.

However, aside from any state initiatives, will the Bush administration and Congress pursue any remedy to the 1.8 million repetitive-stress injuries that are reported annually in the workplace? Can a consensus be reached between business and labor?

Analysts writing for the *New York Times* opine that if the Bush administration is to develop its own rules, much will hinge on whether it can mediate the stark, differing perspectives of business and labor. Business groups insist that there is no need for a federal mandate to reduce musculoskeletal disorders and repetitive-stress injuries. Instead, corporate groups, joined by many Republican lawmakers, contend that businesses will improve ergonomic conditions based on a desire to protect their workers, reduce sick days, and increase productivity.

"Companies are already taking steps to protect their employees," says Ed Gilroy, co-chairman of the National Coalition on Ergonomics, an association of 300 corporate groups that pushed for the repeal of the rules. "Our employees are our greatest resource."

In arguing that federal rules are unnecessary, business groups indicate that due in large part to corporate ergonomics programs, the number of injuries reported annually has fallen in recent years. The coalition notes that Intel, 3M, and several other major companies have eliminated injuries by more than half. Nevertheless, labor unions and many public-health advocates claim that federal regulations are necessary because not all corporations can be trusted to protect workers.

The *Times* also reports that business lobbyists are pushing for Bush administration recommendations, not requirements. Some corporate groups are suggesting that the administration offer a voluntary program that might include guideline manuals containing detailed advice on "best practices" for injury prevention.

"We'd support some voluntary guidelines and manuals describing best practices," says Randy Johnson, vice president for labor policy at the U.S. Chamber of Commerce. "As for mandatory regulation, it would depend on the final details."

May 2001

Congress Moves Quickly to Rescind New Workplace Ergonomics Standard

By Steven J. Storts
Dublin, Ohio

IN what was hailed as a landmark bipartisan move, Congress voted in early March to repeal the Occupational Safety and Health Administration's ergonomics standard that went into effect in January—just four days before President Bush was inaugurated. Organized labor leaders and some congressional Democrats are calling the action shameful, a political payoff to corporate business, and an assault on the health and safety of American workers.

The Senate's surprisingly quick 56-44 vote to repeal the OSHA regulation was followed a day later by a similar 223-206 vote in the House of Representatives, in which Republicans of both chambers gained bipartisan support from Democrats.

To accomplish their objective, the House and Senate invoked a never-used rule under the Congressional Review Act of 1996 that allows for rescinding regulations that are less than 60 days old—all without chamber hearings, committee approval, amendments, or filibuster, and by limiting floor debate to only 10 hours.

Perhaps more significant in terms of political defeat for labor representatives and Clinton administration supporters, under the special rule's provisions, passage of the congressional "Joint Resolution of Disapproval of the Occupational Safety and Health Administration's Ergonomics Rule" prevents any similar ergonomics regulations from being issued in the future.

Critics of the Clinton administration's late-term rules aimed at preventing repetitive-stress injuries in the workplace insisted that OSHA's widespread ergonomics reform was premature and "rushed into effect to reward organized labor for its help to Democrats in the November elections."

Business community representatives, industry executives, and Republican leaders labeled the new federal standard as "probably the most intrusive, expensive, and job-killing regulation ever handed down" or promulgated by government.

In addition to the assertions that OSHA's ergonomics rules were too broad, failed to substantiate direct injury correlations to the work environment, and could impose annual costs of nearly $100 billion on businesses, there was major opposition to the standard's provision that workers injured due to musculoskeletal disorders (MSDs) would receive 90% of their lost pay—a substantial jump from the two-thirds salary figure that is common in most state workers' compensation systems.

Moreover, injured workers placed on restricted or light-duty work could potentially receive 100% in salary replacement, according to the standard's language.

The White House, which had also derided OSHA's finalized standard as too costly and extreme, indicates that the president will sign the congressional repeal. The Bush administration has already reversed two other policies backed by organized labor and issued new executive orders. One directive now makes it easier for union members to stop their dues from financing political activities, and the other revokes the "project labor agreement" mandate, which required contractors on many federally financed projects to be unionized.

Action by Congress didn't arrive too soon for many business and industry groups, some of which had pending legal challenges to OSHA's authority to enforce the ergonomics standard's October compliance date. The U.S. Chamber of Commerce, which claimed that the language of the new regulation was unconstitutionally vague and based on unsound science, had filed a lawsuit in U.S. District Court and was joined by the Labor Policy Association, the Society for Human Resource Management, and the National Beer Wholesalers Association.

Other parties to the lawsuit expressed concern that the finalized standard was based on inadequate science and would be much more costly than projected by OSHA. In support of this view, business group representatives cited government statistics that show that worker complaints of repetitive stress injuries and MSDs have actually declined 34% in the last three years.

Business executives further asserted that the new rule represented "improper governmental meddling" in the workplace, in spite of companies already spending billions of dollars to make production lines safer and workstations more ergonomically sound.

In setting the stage for another legal challenge, this one before the U.S. Court of Appeals for the District of Columbia, the National Association of Manufacturers and other industry coalition groups had alleged that OSHA's economic analysis was "fatally flawed," and that the agency violated procedures in developing the standard.

Patrick Cleary, NAM vice president for human resources policy, claimed

that OSHA's rule could make corporations responsible for aggravating injuries caused by employees' off-the-job activities. "It's OSHA's first big step outside the workplace by defining injuries from elsewhere that are aggravated by work," he said.

Although OSHA had acknowledged that its standard could prove costly, the agency contended that businesses would save money in the long run by preventing MSDs, thereby regaining lost productivity and reducing the number of long-term disability cases.

However, while the agency's fledgling regulation is, in effect, now a dead issue, the subject of ergonomics is not. U.S. Labor Secretary Elaine Chao notes that she is interested in pursuing a more comprehensive approach to ergonomics, one that might include a new rule that better responds to critics' concerns.

Republicans who led the congressional fight against OSHA's standard emphasize that they're not opposed to efforts to protect workers from ergonomic injuries, nor to having OSHA regulate workplace ergonomics; they claim that this particular rule was just badly constructed, hurried, too broad and overreaching, too costly, and neglected using any proven scientific study as a basis of need for regulatory action.

April 2001

Lockheed Martin Expands Lean Practices to Avionics Program Suppliers

By Steven J. Storts
Dublin, Ohio

MANY industrial organizations that have signed on to lean manufacturing practices are continuing to find new ways to ensure the quality and value of their products and services while lowering overhead costs. One organization, the Lockheed Martin Corporation, has expanded its lean manufacturing program to include all production team members.

In 1999, Lockheed Martin's Aeronautics Sector in Fort Worth, Texas, challenged its major suppliers to implement lean practices to improve quality and reduce costs and span times. The focus of the directive was lean supply chain management that emphasizes the critical role the supplier base plays in the success of the corporation's lean supply chain initiatives, and how lean principles can make suppliers more competitive in contracting and procurement.

The Aeronautics Sector is one of the major business centers within the Lockheed Martin Corporation and is composed of the four major aeronautical companies within the corporation: Lockheed Martin Tactical Aircraft Systems, Fort Worth; Lockheed Martin Aeronautical Systems, Marietta, Georgia; Lockheed Martin Skunk Works, Palmdale, California; and Lockheed Martin Aircraft and Logistics Centers, Greenville, South Carolina. Together, these companies comprise the world's largest provider and supporter of military aircraft.

"The key to affordability is the implementation of lean principles to reduce waste, reduce cycle times, improve quality, and lower costs," explains W. A. Blackwell, president and chief operating officer of the Aeronautics Sector. "Since suppliers contribute roughly half the cost of producing aircraft and play a major role in the time span from initial contracting to delivery, it is essential that they join the prime manufacturers in implementing lean practices."

Lockheed Martin's suppliers have already responded. Harris Corp., a key avionics supplier to the Lockheed Martin team, recently completed virtual prototyping of the mission system mechanical design suite for the next-generation Joint Strike Fighter's integrated avionics racks and electronic module components. This move is producing significant cost savings for the program while advancing design and development processes.

Using state-of-the-art, computer-aided design tools and solid structural modeling, Harris engineers were able to interrelate all critical design elements of the JSF as they modeled integrated rack assemblies and components. The result: avionics packages that always fit.

"Call it infrastructure evolution management," says Hal Abercrombie, an integrated products team leader for Harris Corp. "The bottom line is you don't have a dozen or so companies trying to figure out how to get their equipment integrated into Lockheed Martin's airplane. The prototyping initiative drops design and development costs by up to 40% as compared to legacy programs, while extensive use of common components across the JSF mission system suite should bring a 35% reduction in manufacturing, operations, and support costs."

Such an early application of system-level virtual modeling has allowed the Lockheed Martin JSF team to extend the application of common components across all JSF variants and mission system subsystem designs. Additionally, when engineers need to make design changes to racks and subassemblies, the integrated use of automated design and common virtual models enables quick evaluation and ensures the integrity of mechanical tolerances.

This application of virtual prototyping creates design synergism from the airframe structure down to the electronic module mechanical components, where all of the assemblies are modeled as three-dimensional solids. Designs are optimized for cost and weight during an iterative process that ensures design compatibility and maintains physical/mechanical tolerances.

Another supplier to Lockheed Martin, a Massachusetts-based software provider, is helping to reduce costs and increase management effectiveness for the JSF program. The integrated management framework (IMF), an extension of Windchill business software developed by PTC (formerly Parametric Technology Corp.), enables authorized suppliers, partners, subcontractors, and customers to review the status of every JSF system worldwide simply by logging on to the Internet.

The Windchill-based system is designed with open-system architecture that allows for fast and easy modifications as JSF program requirements evolve. "Windchill's most significant strength for the JSF program is the level of integration it

enables," notes Jim Baum, PTC executive vice president. "By taking advantage of the Internet to allow complete integration of multiple systems in multiple locations, Lockheed Martin will be able to more easily manage this cooperative effort while reducing overhead."

Frank Cappuccio, vice president and JSF program manager for Lockheed Martin, says the system takes JSF management efficiency to a new level. "We are continually infusing commercial technology into the JSF program to bring down costs, while providing real-time, desktop information to all the stakeholders. IMF represents a quantum leap."

Cappuccio further points out that his program expects to reap tremendous cost savings as it interfaces with suppliers using business-to-business commercial technology without resulting in a major system upgrade to current supplier hardware. "More than 5,000 users throughout the Lockheed Martin JSF program will have daily access to IMF," he adds.

The JSF team is also capitalizing on new techniques to reduce assembly variation. Through a process called variation management, Lockheed Martin is realizing significant savings through reductions in engineering changes, tooling, scrap, and rework.

VM reduces assembly variation during the design and manufacture of products. The initial phase involves iterative steps to understand requirements, focus emphasis, and use process-capability information to predict the outcomes of assembly and design concepts. Design and assembly options can then be compared and improved before entering production.

As a cornerstone of its VM approach, Lockheed Martin uses Valisys Assembly, a computer-aided design software program from Tecnomatix Technologies Inc. that incorporates digital engineering models, assembly strategies, and process-capability data to predict the performance of key product characteristics.

Valisys Assembly simulations were initially employed to evaluate the effects of variation on the JSF airframe affordability demonstrations. As a result, changes were made to more accurately locate parts within an assembly. The VM process is also being used by the JSF preferred weapons system team to better understand the effect of variation on key assembly characteristics. VM further aided in the development of self-locating strategies that enable workers to put parts together without using a tool. This has resulted in significantly reduced tooling costs.

According to Lockheed Martin, VM brings statistical tools and methods to JSF design and production that are benefitting other company programs, too. For example, using VM on a design of the F-16 forward equipment bay was instrumental in reducing the part count from 90 to 22. Also eliminated were 904 of 1,155 fasteners and 174 of 206 tools. The recurring assembly cost was reduced from $37,500 to $20,900 per unit.

"VM is a proven process but with the JSF program,we're making it even more effective and efficient," Cappuccio emphasizes. "It's clear that VM is reducing costs on an aircraft that already is setting new standards for manufacturing efficiency."

September 2000

Major Industries Forge Ahead with Virtual Work Environments at Home

By Steven J. Storts
Dublin, Ohio

FOR some industries, creating virtual work environments at home might not seem all that practical, cost-effective, or performance-based, but several major corporations are aggressively moving forward with extending the workplace into cyberspace.

Taking advantage of what is already considered a growing trend, Ford Motor Company and Delta Air Lines have launched programs to "cyberfit" their workforces, reporting that they will subsidize most of the costs of installing personal computers, printers, and Internet access into employees' homes. Ford's initiative is expected to be global within a year, and Delta's "Wired Workforce" program is scheduled to be totally functional within a few months.

Technical support and hardware fulfillment for both organizations' efforts are being coordinated by PeoplePC, of San Francisco, which specializes in creating virtual business models and uses its aggregated buying services to purchase computers, printers, and peripheral equipment at substantial discounts from major suppliers like Hewlett-Packard and IBM.

In announcing the PC rollout at Ford, Jac Nasser, company president and CEO, said, "This program keeps Ford and our worldwide team at the leading edge of e-business technology and skills. We're committed to serving consumers better by understanding how they think and act. Having a computer and Internet access in the home will accelerate the development of these skills, provide information across our business, and offer opportunities to streamline our processes."

Ford Chairman Bill Ford noted, "It is clear that individuals and companies that want to be successful in the 21st century will need to be leaders in using the Internet and related technology. That's what this program is all about." Ford observed his company extending the legacy of his great-grandfather Henry Ford into the information age, saying, "The Internet will be the equivalent of the moving assembly line into the 21st century."

Delta, too, is rapidly moving forward with implementation of its "Wired Workforce" program, according to Leo Mullin, company chairman, president and CEO, who says, "I look forward to the advantages our people will gain. We want to give Delta people the opportunity to interact with their company in new and exciting ways. We also believe these tools will help our employees to be more well informed and more productive as they serve our customers."

Other large companies are either in talks to set up similar programs or have already extended their workplaces into the home and on the road, according to Reuters and the Society of Manufacturing Engineers (SME). For example, AT&T has a strong "telecommuting" program in which nearly 25% of its employees telecommute on a regular basis. Its recent program evaluations have yielded less sick leave used, better employee retention, and higher productivity.

In a practical sense, Reuters explains, Ford's assembly line will virtually run into employee living rooms, where they can begin to access human resource records, training programs, and company news via the Internet. However, SME notes that there is some skepticism. "Obviously, they can't take their stamping presses home," says Roger Kay of research firm IDC, "and it's a very expensive proposition, so it's not clear yet what they get from this, except that they will be seen as very forward-looking."

Ford may disagree somewhat with Kay's contention, however. The company has already has additional e-business ventures in the works, including the formation of "autoxchange" with Oracle Corporation and strategic alliances with Microsoft Car Point, TeleTech, Yahoo!, Bolt.com, iVillage.com, and UPS Logistics Group.

The Ford initiative has also been endorsed by organized labor. "This program is a tribute to the collective bargaining process and to our solid relationship with Ford Motor Company," says UAW President Stephen Yokich, and UAW Vice President Ron Gettelfinger adds, "Helping our members stay on top of new technology has always been a UAW priority. That's why we're pleased to help all of our UAW-Ford members get online."

Delta also stresses the importance of management's commitment to employees. "We are proud to extend our partnership with HP and IBM—two world-class computer companies—into the homes of our employees," says Bob DeRodes, Delta chief information officer. "PeoplePC has helped us pull together various product offerings at affordable prices to fulfill the many requests we have had from Delta employees for more options. We plan to offer multiple HP desktop and IBM notebook system packages that will allow each em-

ployee to choose from among great values and leading technology for use at home or on the road."

The growth of home-based work has been largely in the office or white-collar sector, SME points out, so the launch of home-based operations for industrial and service companies like Ford and Delta turned heads. But even in industrial shops like Ford's vehicle plants, the society adds, employees need to stay abreast of training programs and increasingly complex human resource issues.

Both Delta and Ford suggest that their virtual work environments will add productivity by giving people the right tools to work from home. Companies' online portals that carry a steady flow of news and information can help employees feel more connected when they are outside the office, SME observes, but also cautions that there is some concern about a downside to free computers—employees feeling that now they have to work from home at all hours of the day, ending up with less personal time.

Nevertheless, the virtual work environment has drawn the attention of federal lawmakers, who have introduced companion legislation in Congress—both entitled the Telework Tax Incentive Act—that would establish tax credits for expenses paid or incurred under teleworking arrangements for furnishings and electronic information equipment that are used to enable employees to telework.

Under the provisions of H.R. 3819 and S. 2431, employees would be required to telework at least 75 days per year in order to qualify for the tax credit. Both the employer and employee would be eligible under the incentive measures, but the tax credit would go to whomever absorbs the expense for setting up the at-home work site.

July 2000

Auto Industry Looks to Dell Computer For Production, Marketing Techniques

By Steven J. Storts
Dublin, Ohio

THE Ford Motor Company assembly line process—raw materials in one end and vehicles out the other—that catalyzed the automotive industry nearly a half-century ago now has an understudy in quick assembly techniques. Dell Computer is the new kid on the block.

Dell, today's pioneer in making and selling personal computers through mass media campaigns, is blazing a path in much the same manner as Microsoft did last decade with its Windows operating system software.

The Society of Manufacturing Engineers (SME) reports that auto manufacturers seeking to bring their complex products to market more quickly are now looking at the Dell model for assembly. Dell sells PCs direct by telephone or the Internet, assembling customized hardware according to customer specifications.

The company is known for extreme reliance on suppliers for components and mastery of supply-chain management. Recently, General Motors, traditionally considered one of Detroit's most self-sufficient car manufacturers, declared it will seek growth through partnerships and alliances. "This is clearly a different approach," admits John Smith, GM's chief executive officer.

SME points out that General Motors now has a web of alliances with Toyota, Isuzu, Suzuki, and other foreign automakers. Last May, GM released from obligation its captive parts maker, Delphi Automotive Systems, a $30 billion business, freeing Delphi to seek new customers among rival manufacturers. Ford is in the process of following suit with its parts maker, Visteon Automotive Systems.

"That decision was right out of the computer industry's playbook," according to the *New York Times,* which reports, "Selling direct, with no distributors or retailers, Dell is spared the expense of an inventory of finished goods. Its supplier system keeps investment in materials to a bare minimum. The Dell process depends on close tracking of customer demand and sharing that intelligence with its suppliers."

An order in hand before making a car amounts to a manufacturer's "vision of heaven," the *Times* contends. "Today, almost all vehicles are manufactured for dealers' stocks. That requires the automakers to anticipate demand and figure out an attractive product mix." Manufacturers emphasize the difficulty of this marketing strategy in an industry with an estimated 279 model lines sold under 45 different brands and enough color and option choices to make the potential combinations almost infinite. Wrong guesses result in "lot rot," hard-to-sell vehicles piling up expensively on dealers' lots.

"If companies could make cars and add options to order," says Prof. Charles Fine of MIT's Sloan School of Management, "not only could they charge full price, they could completely satisfy the customer, because people will pay more for what they really want." Other vehicle manufacturers are noticing this trend, too, SME observes, noting that Fujio Cho, president of Toyota, has said the time has come to apply his company's mastery of "just-in-time" manufacturing to distribution and marketing.

SME explains that the Dell system's quick response time depends on modularity, "plug-and-play" components that click together, like a home-entertainment system, but this requires an industrywide agreement on performance standards and ease of connection. In the auto industry, primary suppliers like Delphi or Johnson Controls no longer provide mere parts, but complete systems, from climate control or braking to entire interiors or fully equipped cockpits as auto manufacturers are relegating more and more engineering of complex components to suppliers.

"Across the board, more systems, more subsystems, and whole modules are being done by the supplier community," says Harry Pearce, GM vice chairman. He predicts a "shakeout" among suppliers that will produce a half-dozen domineering companies that will then engage in "a natural tug of war" with automakers over controlling vehicle engineering.

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