engineering laboratory

Newsletter • September 2011

What's inside

NIST National Institute of Standards and Technology U.S. Department of Commerce

I am pleased to tell you that my colleague and friend, Dr. Willie E. May, a 40-year veteran of the National Institute of Standards and Technology (NIST) has been named to serve as the agency's Associate Director for Laboratory Programs. In his new position, Willie oversees and guides the management, operation and direction of NIST's six laboratory programs and is the principal deputy to the NIST Director, Dr. Pat Gallagher. In addition to the Engineering Laboratory, NIST's six laboratories include the Physical Measurement Laboratory, Material Measurement Laboratory, Information Technology Laboratory, the Center for Nanoscale Science and Technology and the NIST Center for Neutron Research.

Prior to his current position, Willie served as director of the Material Measurement Laboratory (MML), which serves as the nation's reference laboratory for measurements in the chemical, biological and materials sciences. Before that, he led NIST's research and measurement service programs in the former Chemical Science and Technology Laboratory (CSTL) for more than 20 years. Willie holds several leadership positions outside of NIST, including vice president of the 18-person International Committee on Weights and Measures (CIPM). We look forward to working with Willie in addressing some of the very serious challenges that face the Nation.

As I have related to you before, a key focus area for us is establishing a critical national role for EL in manufacturing R&D. We have been busy strengthening our relationships with our manufacturing stakeholders and have exchanged visits with a number of manufacturing companies of all sizes. These have included Ingersoll Rand/Trane, Marlin Steel Wire, Procter & Gamble, GM, and DuPont.

EL has realigned and strengthened its manufacturing research programs. In FY 2012, this realignment will be reflected in our revised program areas: Smart Manufacturing Processes and Equipment, Next-generation Robotics and Automation, Smart Manufacturing and Construction Systems, Systems Integration for Manufacturing and Construction Applications, and Sustainable Manufacturing.

We are very excited here in EL about the future and want to actively engage the manufacturing sector, and all of our stakeholders, as we plan and execute our 12 research programs and deliver results to end users via standards, products, and services.

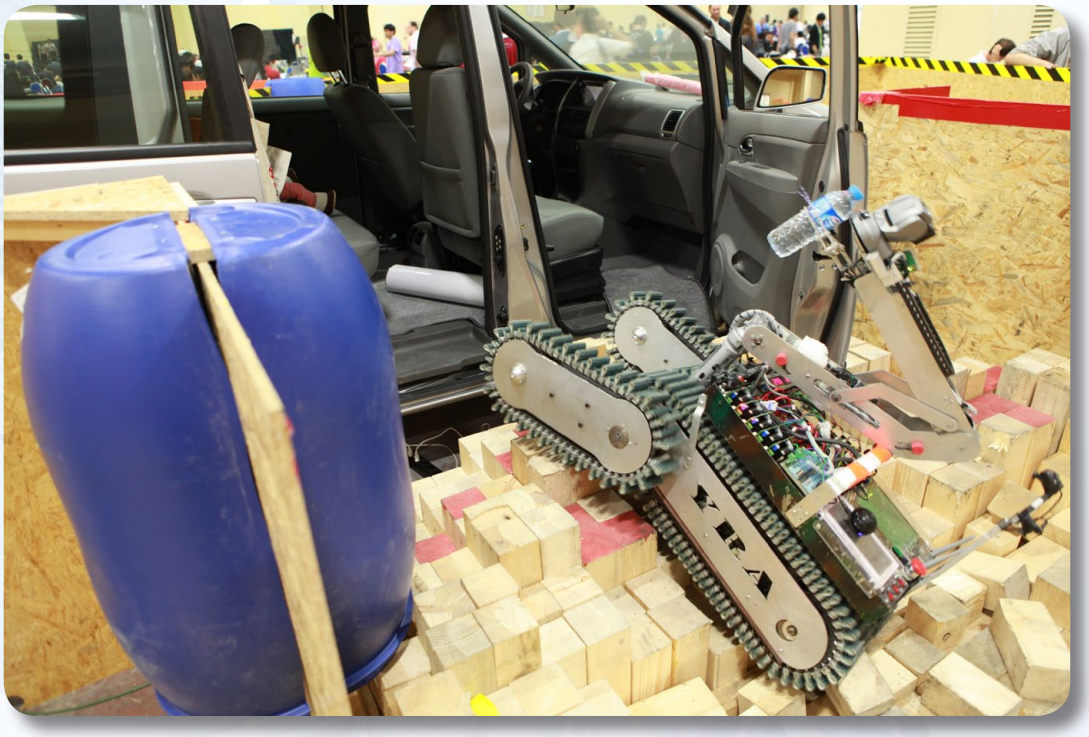
Please visit our website for more information on ongoing activities in the Laboratory: http://www.nist.gov/el/

Sincerely,

Dr. S. Shyam Sunder
Director, NIST Engineering Laboratory

Researchers Lead at World Championship RoboCupRescue Robot Competition Held in Istanbul, Turkey

EL researchers Adam Jacoff and Ann Virts led a team of international robot test administrators to conduct the 2011 RoboCupRescue Robot Competition held in Istanbul, Turkey in July. This World Championship event included 17 teams from 11 countries. The championship was again won by a team from Thailand, which hosts annual regional robot competitions including more than 100 teams. Several strong teams from Japan did not participate in the event given their recent use of their robots to respond to actual disasters in their country. The test arenas that are used to host the competition, challenge the robot teams, and prepare them for fielding are based on more than a dozen ASTM International Standard Test Methods for Emergency Response Robots. NIST leadership in developing these standard test methods through the ASTM Committee on Homeland Security Applications; Operational Equipment; Robots (E54.08.01) is sponsored by the Science and Technology Directorate of the U.S. Department of Homeland Security.



In this scenario a robot searches a compromised/collapsed structure prior to responder entry. Credit: NIST

The competition arena included test courses to conduct standard, draft standard, and prototype tests. The extensive robot performance data collected over more than 120 trials during the week-long event will help NIST efforts to develop and validate new standard test methods. Robots involved in the competition typically deploy the most advanced mobile robot capabilities and autonomous behaviors seen anywhere in the world. New initiatives this year included prototype test courses to measure the performance of 3-D mapping systems in unknown environments with complex terrain, extending the prior emphasis on 2-D mapping. New confined space access challenges were included to challenge robot teams to vertically and horizontally insert sensing and mapping payloads through 15 cm (6 in) bore holes. These capabilities, which are well within reach of many teams in the competition, are a high priority for emergency responders across the country, especially the U.S. Federal Emergency Management Agency (FEMA) urban search and rescue teams.

Several notable robot performances won best-in-class awards for mobility, manipulation, and autonomy/mapping. These teams will take part in NIST's upcoming Response Robot Evaluation Exercise hosted at a responder training facility in Texas called Disaster City, where robot developers, researchers, and emergency responders gather to test robots using the standard test methods prior to deploying them into actual operational scenarios with responders.

For more information: http://www.robocup2011.org/en/

New Website Offers Easy Access to NIST Disaster and Failure Study Data

For more than 40 years, scientists and engineers at the National Institute of Standards and Technology (NIST) have studied structural failures caused by natural disasters, fires and man-made factors, and used the lessons learned to improve building and fire codes, standards and practices. With the launch of the Disaster and Failure Events Data Repository, NIST has begun to make this valuable information accessible more easily online.

The repository will ensure that data collected during and after a disaster or failure event, as well as data generated from related research, is organized and maintained to enable study, analysis and comparison with future severe disaster events. It also will serve as a national archival database where other organizations can store the research, findings and outcomes of their disaster and failure studies.

As the database grows, it will include data on significant hazard events; how buildings and other structures performed during those events; associated emergency response and evacuation procedures; and the technical, social and economic factors that affect pre-disaster mitigation activities and post-disaster response efforts.

The Disaster and Failure Events Data Repository is being established in two phases:

Phase 1—which has just been completed—includes data from NIST's six-year investigation of the collapses of three buildings at New York City's World Trade Center (WTC 1, 2 and 7) as a result of the terrorist attacks on Sept. 11, 2001. Now available are thousands of photos and videos collected during the investigation; computer simulations created to model aircraft impact damage, fire spread and structural design characteristics; and the complete set of technical reports that document the body of NIST's work.

Phase 2 will include a larger collection of information on hazard events such as earthquakes, hurricanes, tornadoes, windstorms, community-scale fires in the wildland-urban interface, structural fires, storm surges, floods and tsunamis, and man-made hazards (accidental, criminal or terrorist).

By making this data available online, NIST hopes to support the development of standards and new technologies that enable more efficient collection of data on disaster and failure events.

NIST is providing these materials as a public service and to comply with regulations that require federal agencies to provide equal access to data available for public release. The materials in the new online repository serve as a historical archive. Some of these materials may contain offensive language or images/videos that some may find graphic. Some of the materials are protected by copyrights owned by private individuals or organizations, and subject to restrictions. Where possible, NIST has identified the copyright owner.

The Disaster and Failure Events Data Repository is accessible at http://wtcdata.nist.gov.

Example of the photos that may be viewed on the new NIST Disaster and Failure Events Data Repository shows a worker from the Federal Emergency Management Agency (FEMA) at New York City's World Trade Center complex a few days after the Sept. 11, 2001, terrorist attacks. Credit: FEMA

Novel Coatings Show Great Promise as Flame Retardants in Polyurethane Foam

Gram for gram, novel carbon nanofiber-filled coatings devised by researchers from the National Institute of Standards and Technology (NIST) and Texas A&M University outperformed conventional flame retardants used in the polyurethane foam of upholstered furniture and mattresses by at least 160 percent and perhaps by as much as 1,130 percent.

The impressive test results, reported in the journal Polymer,* suggest that significant fire-safety advantages can be gained by coating polyurethane foam (PUF) with a club-sandwich-like arrangement of thin layers containing carbon nanofibers and polymers. The upshot, says NIST researcher Rick Davis, is that the experimental coating seems to create the equivalent of a "fire-resistant armor" on the porous foam.

Ignition of soft furnishings account for about 5 percent of residential fires, and the consequences are disproportionately high. These fires are responsible for a third of fire-caused deaths of civilians and 11 percent of property losses due to fires in homes.

The flammability of mattresses is regulated by federal law. A complementary rule to regulate the flammability of upholstered furniture has been proposed recently.

Several organizations, however, have challenged the health and safety of some flame retardants designed to protect against soft furnishing fires. And, a bill pending in California would ban the use of certain halogenated flame retardants in that state.

Today, recipes for making PUFs result in foams in which fire retardants are embedded in the interior. In contrast, the experimental technology uses the carbon nanofiber fire retardant as a coating that covers all the nooks and crannies on the sponge-like PUF surface. The new approach, says Davis, should be attractive to PUF manufacturers because the surface treatment has the potential to deliver a low flammability PUF without major change to the foam manufacturing process, thus saving time and money.

The NIST-Texas A&M team coated square samples of commercially available PUF with four bilayers of a carbon nanofiber-polymer combination.** The average thickness of the coating was about 360 nanometers, increasing the mass of the foam by only 3 percent. By themselves, the carbon nanofibers accounted for 1.6 percent of the foam mass. Since the carbon nanofibers are only in the coating, all the carbon nanofibers are clumped like matted whiskers within the top 360 nanometers of the surface—assembled into the fire-blocking armor.

The team used a standard benchtop fire test to measure the fire performance of coated and uncoated PUF. The carbon nanofiber coatings reduced PUF flammability (measured as the peak heat release rate from an ignited specimen) by 40 percent. That result was more than 3 times better than achieved by putting the same carbon nanofibers in the foam (part of the foam recipe).

When compared at the same concentrations, the carbon nanofiber coating significantly outperforms three classes of commercially available flame retardants commonly used in PUF. Reductions in flammability achieved with the coating, according to the researchers, were 158 percent better than the reduction calculated for nonhalogens, 288 percent better than halogens, and 1,138 percent better than halogen-phosphorous flame retardants.

Additionally, the experimental coating "prevents the formation of a melt pool of burning foam, which in a real fire scenario, may further reduce the resulting fire threat of burning soft furnishings," the authors write.

* Y.S. Kim, R. Davis, A.A. Cain and J.C. Grunlan, Development of layer-by-layer assembled carbon nanofiber-filled coatings to reduce polyurethane foam flammability. Polymer. Vol. 52, Issue 13, June 8, 2011.

**Polyethylenimine/carbon-nanofiber.

North Texas Wildfires Spark Historic Federal-State Collaborative Study

Two wildland-urban interface (WUI) fires* earlier this year outside of Amarillo, Texas, destroyed 70 homes, burned more than 25,000 acres of land, and caused nearly $6 million in property damage. But thanks to a collaborative effort between the National Institute of Standards and Technology (NIST) and the Texas Forest Service (TFS), they are now the most thoroughly investigated and scientifically evaluated events of their kind.

During a three-week reconnaissance following the start of four fires in the Amarillo area on Feb. 27, 2011, a NIST-TFS study team—for the first time in an actual fire situation—used a NIST-developed, two-tiered WUI data-collection methodology to acquire approximately 163 gigabytes of data and more than 29,000 photographs to document two of the blazes, now known as the Willow Creek and Tanglewood Complex fires.

This massive amount of accumulated information is the foundation of a NIST-TFS study assessing the impact of the two wildfires on structures in the region. The first report from that study** is now available online at www.nist.gov/manuscript-publication-search.cfm?pub_id=908719.

"We gathered as much data as possible to document the topographical features of the region, detail the types and construction of structures that were impacted or endangered by the fires, identify defensive actions taken, and develop a timeline of the fires movement and spread," says NIST fire protection engineer and Amarillo study team leader Alex Maranghides. "This will allow us to understand why some structures burned to the ground while others close by did not. That knowledge could help us build more fire-resilient buildings in the future."

A member of a joint NIST-Texas Forest Service study team collects data on an Amarillo, Texas, building damaged by wildfires in February 2011.

Credit: NIST

Fortunately, Maranghides had trained TFS field investigators last fall on the use of the NIST data collection methodology, so they were in the field employing the two-tiered system within 48 hours of the start of the Amarillo fires. The first tier—a survey for recording broad observations of damage across the entire fire perimeter—provides input for the second tier. The latter includes a kit with tools designed to capture the specific details needed for developing a precise fire timeline, building computer models to study a fire's behavior in depth, and most importantly, identifying and assessing all of the factors that determine the response of different structures to a WUI fire (such as the types and amounts of combustibles on or around a structure). Maranghides and colleague Glenn Forney traveled to Texas in early March 2011 to assist the TFS investigators with their reconnaissance and to evaluate how the NIST data-collection system performed in the field.

"The level of detail that can be obtained with our system is a vast improvement over traditional data-collection procedures that focus simply on the number of structures damaged or destroyed, without taking into account the underlying factors that actually cause the destruction," Maranghides says.

* The U.S. Department of Agriculture Forest Service defines a WUI as "an area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels." WUI fires are growing more prevalent as housing developments push into wilderness areas.

** A. Maranghides, W. Mell, K. Ridenour and D. McNamara. Initial Reconnaissance of the 2011 Wildland-Urban Interfaces Fires in Amarillo, Texas (NIST Technical Note 1708). July 2011.

The fact that TFS staff had canvassed the Tanglewood Complex last October to assess its susceptibility to a wildfire event was an added bonus for the NIST-TFS study. "This gave us the unique advantage of having data collected about the area before, during and after the fire," Maranghides says.

The Amarillo study is part of a broad NIST program to study WUI fires around the nation to gain a better understanding of their behavior; develop and standardize data collection and computer modeling tools; and facilitate the creation, testing and implementation of innovative fire protection and prevention methods. These research efforts will lead to improved standards, codes and practices to address WUI fires in the United States.

For more information about NIST's WUI fire research, go to nist.gov/el/topic_wui.cfm.

For more information about the TFS and its partnership with NIST on this study, contact Linda Moon, TFS Communications, (979) 458-6606, lmoon@tfs.tamu.edu.

NIST to Conduct Technical Study on Impacts of Joplin, Mo., Tornado

The National Institute of Standards and Technology (NIST) will conduct a full technical study on the impacts of the May 22, 2011, tornado that struck Joplin, Mo.

The massive tornado was rated category EF5, the most powerful on the Enhanced Fujita scale. According to the National Weather Service (NWS) and the Federal Emergency Management Agency (FEMA), the multiple-vortex storm impacted an area approximately three-quarters of a mile wide by 14 miles long, destroyed some 8,000 structures in its path, and killed more than 150 people. This makes it the single deadliest tornado in the United States in the 61 years that official records have been kept.

"The widespread destruction across a range of building and construction types, along with the tragically large death toll despite a comparatively substantial warning time, makes the Joplin tornado a unique event to research," says Marc Levitan, leader of the NIST study. "The lessons learned will be extremely valuable to national efforts aimed at reducing losses of lives and property from tornados."

From May 25-28, NIST sent four engineers to Joplin to conduct a preliminary reconnaissance of building performance and emergency communications during the tornado. Based on the analysis of the data collected and other criteria required by regulation, NIST Director Pat Gallagher established a research team under the National Construction Safety Team Act to proceed with a more comprehensive study of the impacts of the disaster.

The objectives of the NIST technical study are to:

- determine the characteristics of the wind hazard from the tornado;
- determine the pattern, location and cause of injuries and fatalities, and how these numbers were affected by emergency communications and the public response to those communications;
- determine the performance of residential, commercial and critical (police stations, firehouses, hospitals, etc.) buildings;
- determine the performance of lifelines (natural gas, electrical distribution, water, communications, etc.) as they relate to maintaining building operation; and
- make recommendations, if warranted, for improvements to building codes, standards and practices based on the findings of the study.

The same engineers who performed the preliminary reconnaissance will conduct this more extensive study. They will be joined by an expert on severe storms from the Commerce Department's National Oceanic and Atmospheric Administration (NOAA).

Observations and findings from the preliminary reconnaissance suggest the following:

- The current tornado rating procedure, the Enhanced Fujita intensity scale, lacks adequate indicators for estimating the intensity of tornados such as the one in Joplin.

The remains of what was once a home improvement store in Joplin, Mo., showing the destructive power of the tornado that struck the area in May 2011.

Credit: NIST

- The 24-minute warning time for this event was nearly double the national average reported by the NWS as 13-14 minutes.
- The Joplin siren-based warning system was not intended to alert people who were indoors.
- There were no designated public safe rooms or tornado shelters in Joplin.
- Most buildings in Joplin did not have basements.
- A large number of residential and non-residential buildings in Joplin sustained complete loss of function, requiring either major repair or replacement.
- Critical and high-occupancy buildings in Joplin did not perform better than buildings of similar construction type in lower-risk categories with regard to loss of function or damage.
- Reinforced concrete frame and steel frame buildings that were surveyed also suffered total loss of function and major damage to the envelope and interior; however, the structural frame remained largely intact.
- Most other buildings, including those constructed with pre-cast concrete, metal, concrete and brick masonry, and wood-frame, suffered partial or complete collapse.

Both the NIST preliminary reconnaissance and the upcoming technical study led by NIST build on a partnership between the agency's Disaster and Failure Studies Program and the interagency National Windstorm Impact Reduction Program. For more information on the Joplin tornado study, and NIST's 40-plus years of experience studying structural failures and fires, visit www.nist.gov/el/disasterstudies/index.cfm.

The Heat Is On: NIST Zeroes In On Energy Consumption of Ice Makers

In tests of four different types of new refrigerators, National Institute of Standards and Technology (NIST) researchers found that ice makers increased rated energy consumption by 12 to 20 percent. About three-fourths of that additional energy cost is due to the electric heaters used to release the ice bits from the molds.

With only one-fourth of the extra energy actually used to cool and freeze water, "there are substantial opportunities for efficiency improvements merely by optimizing the operations of the heaters associated with the ice makers" or by introducing a more efficient alternative technology, report NIST mechanical engineer David Yashar and guest researcher Ki-Jung Park.*

Since refrigerators account for 8 percent of the total energy consumed by 111 million U.S. households according to the Department of Energy (DOE), the potential savings are significant.

Currently, ice maker energy consumption is not reflected in federal minimum efficiency standards for refrigerators or in the voluntary Energy Star program, which requires energy usage to be significantly lower than the regulatory limit.

DOE, which helped to fund the NIST study, has announced that it will increase the minimum efficiency standard by 25 percent over the current level, starting in 2014. DOE also intends to incorporate the energy used by ice makers into their regulatory test. Because no widely accepted test for ice makers was available when they announced these intentions, DOE plans to add 84 kilowatt hours to the energy efficiency rating of every refrigerator equipped with an ice maker, Yashar explains.

Once a reliable, straightforward test is available, he adds, DOE will eliminate the "placeholder" energy consumption and use actual ice maker test results in efficiency ratings.

To speed progress along this path, Yashar and Park evaluated several different approaches to measure the energy consumption of ice makers. Their goal was to identify a method that consistently yielded accurate results but did not add substantially to the complexity of appliance energy consumption tests under current regulations.

Yashar and Park examined four refrigerators, which sampled a variety of ice maker technologies. Their study used a uniform test setup, consistent with current regulatory procedures, and measured the energy consumption of the four units while their ice makers were actively producing ice and, again, while the ice makers were not operational.

The results point the way to a standard test methodology that appears promising for several different ice maker technologies and configurations. Next steps include sharing their approach with other laboratories, which also will test ice makers and compare results for similar units. Also, Yashar says he intends to evaluate the measurement techniques on other styles of automatic ice makers.

One of four types tested by NIST researchers, this top-mount refrigerator freezer was outfitted with three thermocouples in each compartment, sampling the temperature every 30 seconds. In all units tested, about three-quarters of ice-maker energy consumption was directly and indirectly attributed to the electric heaters used to free ice from molds

Credit: NIST

*D.A. Yashar and K.J. Park, Energy Consumption of Automatic Ice Makers Installed in Domestic Refrigerators. NIST Technical Note 1697, April 2011.

Free On-Line Tool Aids Decisions on Fire Sprinkler Systems for Homes

For the many states, communities, new-home builders, and prospective buyers now mulling over the pluses and minuses of installing residential fire suppression sprinklers, the National Institute of Standards and Technology (NIST) has developed a free on-line tool to help them sort through the costs and benefits of the technology.

NIST's new, Web-based "sprinkler use decisioning" tool, developed by information technology specialist Priya D. Lavappa and economist David Butry, enables experts and non-experts alike to assess the cost-effectiveness of fire sprinklers for their particular jurisdiction, development, or dwelling.

Fewer than 5 percent of U.S. homes are equipped with fire-suppression sprinklers, but recent developments have moved the cost-benefit debate into the main-stream. The latest version of International Residential Code (IRC) calls for fire sprinklers to be installed in new one and two-family residential dwellings and townhouses, starting Jan. 1, 2011. Some other model building codes follow suit.

More than 200 communities and a handful of states, including California, Maryland, and South Carolina, have adopted the code. So has Pennsylvania. But the Pennsylvania House of Representatives recently voted to repeal the mandate, sending the measure on to the State Senate for its consideration. Debate and disagreement over proposed sprinkler ordinances have flared in other areas as well.

The NIST tool can help to inform these kinds of policy discussions, providing the means for "apples to apples" comparisons of different installation scenarios. It is based on the economic framework that Butry and other NIST researchers developed in their 2007 Benefit-Cost Analysis of Residential Fire Sprinkler Systems.*

Users can input their own data to supply values for categories of costs and benefits in the model. They also can opt for a combination of user-defined data and national or local statistics. The NIST developers mined the National Fire Incident Reporting System (NFIRS) to assemble national and city-level data on fire risk, fire fatality and injury rates, property loss, and other figures of merit. NFIRS contains fire-related data for more than 1,300 cities.

By researching and supplying their own data on local sprinkler installation and maintenance costs, insurance premiums and credits, value of the house and contents, discount rate, and other variables, users can get a realistic estimate of the cost-effectiveness, or "present value net benefits," of an investment in a sprinkler system.

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The tool supports two types of analyses. A baseline analysis yields a single present value estimate for each benefit and cost and an overall estimate of "present value net benefits." The tool's sensitivity analysis allows users to input maximum and minimum values for each input. Through the sensitivity analysis, they can assess the soundness of their estimates of individual costs and benefits.

"With this type, you can also identify the largest and smallest drivers of the total economic performance of sprinklers," Butry explains.

For local government officials contemplating whether to add the sprinkler requirement to their building codes, Butry recommends running analyses for a variety of house sizes to explore the benefit-cost performance of sprinkler systems in a community with a diversity of residential styles and sizes.

You can check out NIST's new sprinkler use decisioning tool at: http://ws680.nist.gov/firesprinkler/default.aspx

*Available at: http://www.nist.gov/manuscript-publication-search.cfm?pub_id=860105

Prefabrication and Modularization: Increasing Productivity in the Construction Industry

The Prefabrication and Modularization* report was produced by McGraw-Hill Construction in partnership with NIST and other corporate and association research partners. The report shows how prefabrication and modularization is yielding real business benefits to users. Commonly used prefabricated and modular building elements include: mechanical, electrical, and plumbing systems; exterior walls; building superstructures; roofing; floors; and interior room modules. Out of over 800 architecture, engineering, and contracting (AEC) professionals surveyed, 66 % report improved project schedules, 65 % report decreased project costs, and 77 % report reduced construction waste.

Increased adoption of Building Information Modeling (BIM) is also fueling the reemergence of prefabrication and modularization as a critical new trend. The report shows that BIM and prefabrication/modular construction improve both worksite productivity and overall project ROI.

The Prefabrication and Modularization report provides data and analysis on the impact of this trend on key industry productivity metrics, such as project schedules, costs, safety, quality, and eliminating waste. Significant findings include:

- According to respondents, the main drivers for prefab/modular use are to improve productivity, attain a competitive advantage, and generate greater ROI.
- Productivity improvements include decreased project schedules (66 % report a positive impact—35 % say it's by four weeks or more), decreased costs (65 % report a positive impact—41 % say budgets decreased by 6 % or more), and decreased construction site waste (77 % report a positive impact—44 % say waste was decreased by 5 % or more).
- Architects cite owner resistance as the primary reason for not incorporating prefabrication/ modularization into their projects; while engineers and contractors said they don't use it because it is not in the architects' designs.

Shutterstock/benicce

- By 2013, nearly all AEC professionals (98 %) expect to be doing some prefabrication and modularization on some projects.

*Available at: http://www.nist.gov/el/economics/upload/Prefabrication-Modularization-in-the-Construction-Industry-SMR-2011R.pdf

NIST Selects First Chief Manufacturing Officer

The National Institute of Standards and Technology (NIST) announced that manufacturing industry executive Michael F. Molnar has been appointed to be the agency's first-ever Chief Manufacturing Officer.

The manufacturing sector is critical to the U.S. economy, and the Obama administration is committed to building domestic manufacturing capabilities to create the new products, new industries and new jobs of the future. NIST is particularly well-positioned to support this goal because of its unique mission to work closely with industry. This new position will leverage NIST's strong relationships with industry to accelerate innovation that will create 21st-century manufacturing jobs and enhance our global competitiveness. As part of this effort, the position will support the broader Advanced Manufacturing Partnership recently launched by President Obama that brings industry, universities and the federal government together to invest in emerging technologies.

"We look forward to having Mike join the NIST team," said Under Secretary of Commerce for Standards and Technology and NIST Director Patrick Gallagher. "His background in manufacturing research and development, collaborative engineering, and sustainable products and processes, combined with his policy experience, make him uniquely suited for this position."

As Chief Manufacturing Officer, Molnar will be responsible for planning and coordination of the Institute's broad array of manufacturing research and services programs. He will serve as NIST's central point of contact with the White House, the Department of Commerce and other agencies on technical and policy issues related to manufacturing.

Molnar has extensive industrial experience, with leadership roles in manufacturing technology, advanced manufacturing engineering, metrology and quality systems. He currently serves as Director of Environmental Policy and Sustainable Development at the Columbus, Ind., headquarters of Cummins Inc. Cummins is a $14 billion international company that designs and manufactures commercial engines and power generation systems.

Molnar has served as a federal fellow in the White House Office of Science and Technology Policy, and was elected as a fellow of both the American Society of Mechanical Engineers and the Society of Manufacturing Engineers. He is a licensed professional engineer, a certified manufacturing engineer and a certified energy manager.

Molnar received a Master of Business Administration from the University of Notre Dame in Indiana and both a Master of Science in manufacturing systems engineering and a Bachelor of Science in mechanical engineering from the University of Wisconsin-Madison. He is an active member of professional societies, consortia and volunteer organizations.

Staff Awards

2011 Roon Foundation Award

Tinh Nguyen, Coralie Bernard, Xiaohong Gu, Debbie Stanley, Marc Nyden, and Joannie Chin

Awarded by the American Coatings Association

In recognition of their technical paper

"Multifunctional Properties Enhancement of Waterborne Polyurethane Coatings with Graphene Oxides"

Left to Right: Joannie Chin, Tinh Nguyen, Debbie Stanley, Xiaohong Gu

Recent Publications

A. S. Rushing, J. D. Kneifel, B. C. Lippiatt, *"Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis 2011"* NIST Interagency/ Internal Report (NISTIR) 85-3273-26, 64 pp., (08-Sep-2011) (PubID: 909539) - (ERB Control #: G2011-1651)

G. Donovan, D. T. Butry, *"The effect of urban trees on the rental price of single-family homes in Portland, Oregon"* Urban Forestry and Urban Greening, Vol. 10, 6 pp., (01-Aug-2011) (PubID: 907993) - (ERB Control #: G2011-0748)

Working with EL

For more details, please visit the EL Career website.

For more information about EL, please visit our website at www.nist.gov/el/

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