

WHAT'S TRENDING NOW:

What you need to know to keep pace with our rapidly changing industry

Inside this issue

RESHORING:

The move to bring production back to the U.S.
pp.16-19

AUTOMATION:

One company's journey. p.21

TRUMP ERA TARIFFS:

What it means for the industry right now. p. 22



2018 EVENTS

LEARNING

- ✓ Software Bootcamp • Cleveland, OH • May 10—11
- ✓ Big Hairy Audacious Growth Conference • St. Louis, MO • June 6—8
- Emerging Leaders Roundtable • Nashville, TN • August 22

GLOBAL

- Japan Tour • Japan • April 22—28 ✓

NETWORKING

- ✓ Chapter Leadership Summit • New Orleans, LA • January 28—30
- ✓ MFG Meeting • Miami, FL • March 7—10
- ✓ Emerging Leaders Conference • Pittsburgh, PA • April 30—May 2
- Fall Conference • Denver, CO • October 23—26

ADVOCACY

- Legislative Conference • Washington, DC • April 16—18 ✓
- NRL Competition • California, PA • May 18—19 ✓

TABLE OF CONTENTS

PRESIDENT'S UPDATE 4

2018 EVENTS 2

2018 FALL CONFERENCE 35-46

NTMA NEWS

NTMA WELCOMES NEW MEMBERS 3

NTMA EXECUTIVE COMMITTEE APPROVES NEXT PRESIDENT, DR. DEAN BARTLES . . . 7

GRAINGER MARKET BASKETS – WHERE TO FIND THE SAFETY PRODUCTS

YOU NEED AT THE BEST PRICES 7

NRL RAFFLE 8

NTMA EXCLUSIVE FOR MEMBERS ONLY: TECH TOURS IMTS 2018 9

NTMA IS NOW ACCEPTING APPLICATIONS FOR GS AWARD. 9

CHAPTER NEWS

NTMA SOUTHWEST REGIONAL CONFERENCE 3

MEMBER NEWS

BETAR, INC.: FIFTY GOLDEN YEARS OF SUCCESSFUL DRILLING 15

MEET OUR NATIONAL ASSOCIATE: MAKINO. 19

CONSIDERATIONS FOR MACHINE MONITORING IN JOB SHOPS. 30

ACUTEC PRECISION AEROSPACE ANNOUNCES NEW VETERAN

CAREER PROGRAM: ACUVETS 31

"NO MAN IS AN ISLAND..." 31

ALLIED MACHINE PARTNERS WITH LA/NTMA TRAINING CENTER. 32

GLOBAL SHOP SOLUTIONS CELEBRATES 25-YEAR ANNIVERSARY OF

ERIKA KLEIN, VICE PRESIDENT OF R&D 33

IT ALL ADDS UP: THE OPERATIONAL COSTS OF MOVING FREIGHT 33

FEATURES

TOP COMPANIES CONNECT WITH THEIR EMPLOYEES 11

TRENDING NOW: APPRENTICESHIPS. 13

IS THE TIME RIGHT FOR RESHORING? 16-19

CUSTOM TOOL'S QUEST TO AUTOMATE 21

THE CHALLENGE OF TARIFFS 22

USING DESKTOP 3D PRINTING TO GET MORE OUT OF CNC MACHINES. 23

MFG DAY – OPEN YOUR DOORS, OPEN THEIR MINDS 28

KEYS TO SUCCESS FOR VENDOR COMPLIANCE AND INBOUND SHIPPING 47



LOOK FOR THIS SYMBOL THROUGHOUT THE ISSUE FOR STORIES
RELATED TO THIS MONTH'S FEATURED TOPIC.



NATIONAL TOOLING AND MACHINING ASSOCIATION

75 YEARS OF MANUFACTURING SUCCESS AND EXCELLENCE



In 2018, the National Tooling and Machining Association is celebrating our 75th Anniversary. We'll share stories, information and the history of the organization throughout the year. Do you have something that you would like to share? Please contact Kelly LaMarca at kلاماركا@ntma.org with any stories, photos or ideas. We look forward to celebrating our diamond anniversary together!



WELCOMES NEW MEMBERS

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Bob Petrini
118 Chick Lane
Butler, PA 16002

GOLDEN WEST MACHINE, INC.

Los Angeles Chapter
Dan Goodman
9930 Jordan Circle
Santa Fe Springs, CA 90670

IMS, INC.

General
Pete Willis
1268 Highway 67 South
Decatur, AL 35603

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33 John Street #39
New Britain, CT 06051

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Northwestern Pennsylvania
Chapter
James Burns
P.O. Box 534
Meadville, PA 16335

PUEHLER TOOL COMPANY

Cleveland Chapter
William J Puehler
7670 Hub Parkway
Cleveland, OH 44125

RUCO, INC. DBA REGAL MOLD & DIE

Michiana Chapter
Amy Stutzman
1817 Leer Drive
Elkhart, IN 46514

SHERMAN TOOL & GAGE

Northwestern Pennsylvania
Chapter
Andy Machuga
1624 Cranberry St
Erie, PA 16502

TOPFLIGHT MACHINE TOOL LLC

Connecticut Chapter
Elizabeth Kusmider
90 Robert Jackson Way
Plainville, CT 06062



SAVE THE DATE

NTMA SOUTHWEST REGIONAL CONFERENCE

- February 8 and 9 in Southern California
- Seminars
- Networking
- Education
- and more

Registration will be available soon



PRESIDENT'S UPDATE

Industry Trends

DAVE TILSTONE / NTMA PRESIDENT



New technologies are being introduced at a pace never seen before in our industry. Industry 4.0, the Internet of Things (IoT), blockchain, MT Connect and apps for CNC controls are all changing the way you operate your business, manage your supply chain and have led your customers to set high expectations. These put demands on your business, the type of investments you make in both equipment and people, but more importantly, they are making your business more sophisticated and you more informed. Data collection technologies are exploding with the price of sensors on machines at a fraction of the cost they were a few years ago. How you use the new technologies to leverage them for better service, quality and profitability is the challenge. IMTS is an excellent venue to explore these new technologies so be sure to go with a plan, set up appointments and take advantage of our IMTS Tech Tours. These Tech Tours are organized by NTMA's National Accounts Manager, James Mayer, and are designed to provide NTMA members a 30-45 minute overview of booths. The world's leading technology companies (our National Associates) will host the tours that will be guided by executives of these companies. You'll see the newly introduced technologies on a private tour for NTMA members only and discuss how they could impact your business. These tours will be held on Tuesday through Thursday at IMTS and will be held on a fixed schedule. Space is limited so please contact James Mayer (jmayer@ntma.org) to be sure you reserve your spot because they have become very popular.

This edition of The Record addresses new technologies and industry trends. Additive Manufacturing seems to have taken a back

seat to other trends in the market, however it shouldn't be ignored. The impact of additive is yet to be seen with major corporations investing billions of dollars on further developing this technology. Many of our members are venturing into additive through service providers. I have also seen members purchase additive equipment to make fixturing, especially to hold parts being measured on CMMs. For low quantity, complex parts, additive has always been top of mind. Providing near-net shape parts that minimize the machining required is an ideal opportunity for additive. Keep yourself informed on additive because the technology for solid metal parts is overcoming some of the challenges of the past that will make additive an economic and preferred choice in the near future.

Another industry trend involves collecting all the data available to you from your machines and ERP systems and displaying them on a dashboard. This dashboard can be tailored to your specific key performance indicators and help you manage your workflow by reducing bottlenecks, quantifying your machine utilization and providing real time information on your processes. Some customers will, if they haven't already, want to know about their order and request access to this data. With cyber security top of mind for all of us, providing access to your customers and supply chain is your IT staff's nightmare. This is where blockchain could come into play.

Blockchain as described by Wikipedia (<https://en.wikipedia.org/wiki/Blockchain>): A **blockchain**,^{[1][2][3]} originally **block chain**,^{[4][5]} is a growing list of records, called blocks, which are linked using cryptography. The cryptotechnology of blockchain is often associated with cryptocurrencies such

as bitcoin. Blockchain is already making a significant impact with securing business transactions and is often cited as the most secure technology for data transfer. As more and more data is exchanged between businesses, this will become more of a household word in our industry.

The interface between your machine tools and personnel is also getting simplified. With apps being part of the controller, the operator interfaces for common tasks and programming are simplified to improve productivity and help overcome some of the training required for the operator. The interface between machines, robots and metrology equipment has been standardized with MT Connect. Although not a new technology, it is becoming more popular with many controllers on equipment having MT Connect built in. This is especially important when you have multiple brands of machines and equipment. The software that collects this data and displays it as noted above is providing useful and real time information to you and your personnel. Making decisions based upon the data collected is now reliable and timely.

Robots are without a doubt becoming prominent in all size manufacturing facilities. Aided by "intelligent" robots, the programming and ease of use of robots is assisting shop floor operations that eliminate redundant and repetitive tasks while offering a safer workplace. Machine learning makes the implementation and continuous improvement aspects of robots a plus.

The technology landscape continues to evolve and keeping pace with all the change is the challenge. I strongly recommend that you come to the Fall Conference and learn more as well as attend the Ignite Sessions.

SEE PRESIDENT'S UPDATE NEXT PAGE

THE RECORD

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Molly West, Editor

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To advertise in *The Record*, or for information on publishing your corporate newsletter or sales literature, contact NTMA at (216) 264-2847 or mgilmore@ntma.org for advertising, mwest@ntma.org for editorial content.

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NATIONAL TOOLING & MACHINING ASSOCIATION

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Cleveland, OH 44134

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NTMA NEWS

PRESIDENT'S UPDATE CONTINUED

This year, session topics include:

- 6S/Lean – Creating a Workplace That is Safe, Clean, Efficient and Productive
- Analytics and Information Management – Ensuring Our Data is an Asset
- Team Engagement – Developing a Culture That Thinks and Acts Like Owners
- The Future of Manufacturing – Implementing the Essential Technologies.

The Technology Team has worked hard to make the subjects of the Ignite Session relevant and pertinent by having subject matter experts and NTMA members discuss their experiences. As noted earlier, attending IMTS this year is one of the best ways

to learn more about new technologies and speak to experts about the applications specific to your company.

Fast-paced industry changes can be overwhelming as you navigate day-to-day operations. Not to worry. NTMA is your information source with the resources to help your company not just grow, but thrive.

DAVE TILSTONE / NTMA PRESIDENT



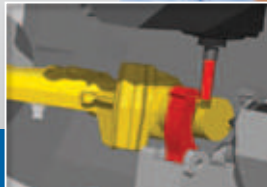
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NTMA BOARD OF TRUSTEES APPROVES NEXT PRESIDENT, DR. DEAN BARTLES

A MESSAGE FROM NTMA CHAIRMAN MARK VAUGHN

As you may be aware, a succession plan and working timeline was prepared in preparation for the retirement of current NTMA president, Dave Tilstone in August of 2017. In October of 2017 at our Fall Conference in San Antonio, the Board of Trustees was notified of Dave's retirement plans. Dave's contribution to our Association has been immeasurable.

The Executive Committee formally initiated a search plan on November 15, 2017. The executive search process concluded with an employment offer to Dr. Dean Bartles for the position of President on

June 20, 2018. With a 30 day due meeting notice, the Board of Trustees unanimously approved Dr. Dean Bartles as President of the Association on July 23, 2018.

Dean's first day as President was August 20, 2018. Dean resides in Cleveland, OH and works out of the NTMA Headquarters office.

Dr. Bartles has a Ph.D. in Technology Management with a concentration in Manufacturing Systems, a Doctorate and a Master's degree in Business Administration, and a Bachelor's of Science in Business Administration. He has extensive experience

in the manufacturing industry, and has held several Officer positions in manufacturing institutions.

His *introduction letter* and resume can be downloaded for your review.

Please join me in welcoming Dean Bartles to the NTMA family! Please look for additional details in an upcoming issue of The Record.



GRAINGER MARKET BASKETS – WHERE TO FIND THE SAFETY PRODUCTS YOU NEED AT THE BEST PRICES

NTMA has partnered with Grainger, the national industrial supply and safety experts, to help members get safety done. The NTMA Grainger safety market basket, available on the Grainger.com homepage when you are logged in under your NTMA account, has over 180 essential safety items at great pricing only to NTMA members. From gloves to eye protection to safety harnesses, the mar-

ket basket has been designed specifically as a one-stop safety shop for NTMA member companies.

To find the safety basket, log into Grainger.com with your NTMA-aligned account and you will find it in the top right-hand corner of the landing page under "My Lists." For more information on the safety market basket or to access your NTMA member Grainger ac-

count, please contact Matt Gilmore, Director of Membership and Business Development at mgilmore@ntma.org.

GET SAFETY DONE RIGHT BY USING THE NTMA GRAINGER SAFETY MARKET BASKET.



The screenshot shows the Grainger.com website interface for an NTMA member. At the top, there's a navigation bar with links like 'My Account', 'Order History', 'Lists', 'Catalog Item Quotes', and 'Special Order Quotes'. Below this is the Grainger logo and a search bar. The main content area is divided into sections: 'All Products' (with a dropdown menu), 'Orders' (showing 'You currently have no recent orders'), 'Invoices' (showing 'You currently have no invoice history within the past 10 months'), and 'My Lists' (showing 'Safety Supplies' with 184 products, updated 2/14/2018). A banner at the bottom promotes the 'National Tooling & Machining Association & Grainger General Supplies Contract' with a 'View Contract Benefits' button. The right sidebar shows a 'CART' icon and a 'Sign Up for Email' link.

ENGAGE MANUFACTURING'S NEXT GENERATION RAFFLE

TO BENEFIT THE NATIONAL ROBOTICS LEAGUE
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All proceeds to benefit the National Robotics League, NTMA's job-driven, project-based STEM learning experience to close the skills gap and promote pathways to careers in manufacturing.

**THE DRAWING WILL TAKE PLACE AT THE NTMA FALL CONFERENCE ON
OCTOBER 24, 2018 AT 7 PM.**

Winner does not need to be present to win and will not be responsible for any taxes if the prize is donated directly to a school or qualified youth organization.



PURCHASE TICKETS AT [HTTPS://TINYURL.COM/NRLRAFFLE](https://tinyurl.com/NRLRAFFLE)

NTMA EXCLUSIVE FOR MEMBERS ONLY: TECH TOURS IMTS 2018

BY JAMES MAYER, NTMA, NATIONAL ACCOUNT MANAGER

Looking back at my career, I have attended and worked at many trade shows, but when faced with the sheer size of IMTS, I will admit, I am a little intimidated. With over 2,400 exhibiting companies displaying products, technology, and productivity solutions, I realize there is no way I would be able to visit with each company and have a meaningful conversation. Thankfully, the NTMA has designed a way to bypass the congestion of booths and connect members directly with company executives who will provide guided tours of their booth, giving our members a clear path

to viewing those products, technologies, and productivity solutions. The NTMA calls these IMTS Tech Tours.

Tech Tours are FREE, one hour long sessions with NTMA National Associate Members designed to give insights on industry trends and show members the technology firsthand that may affect business strategies. Members will learn about new technology directly from cutting tool and machine tool manufacturers, hear about the processes of heat treating, gain a new and better understanding of what software solutions are avail-

able, and learn how to deploy them in their companies. Tech Tours are strictly for NTMA members and we aim to provide exposure to many different companies and their products. This is an excellent chance to network with the National Associate Members and potential future partners and to discuss your business in a unique setting that in the end will make your businesses stronger and more successful.

Please join us at IMTS 2018 NTMA Tech Tours. To register, please contact Brittany Belko @ bbelko@ntma.org or 216-264-2848.



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NTMA IS NOW ACCEPTING APPLICATIONS FOR 6S AWARD

The NTMA Technology Team is committed to improving the perception of American manufacturing by promoting and recognizing excellence in member shops. The 6S Excellence Award is specifically designed to honor shops that display excellence in organization and efficiency.

COMPANIES APPLY FOR THE AWARD BY SUBMITTING A SELF-ASSESSMENT BASED ON CRITERIA THAT DEMONSTRATES BEST IN CLASS PRACTICE IN THESE SIX CATEGORIES.

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SAFETY



SORT



SET IN ORDER



SHINE



STANDARDIZE



SUSTAIN

Recipients of the 6S Award are presented with a Certificate of Excellence at the NTMA Fall Conference which will be held in Denver, Colorado, October 23-26.

For the 6S audit worksheets and application go to <http://ntma.org/resources/documents/6S-excellence-program/> or contact Christine Benco at 216-264-2835 or cbenco@ntma.org

The deadline for applications for the 6S Award is September 28, 2018.

The Technology Team looks forward to presenting the 6S Award to you this year!



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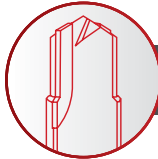
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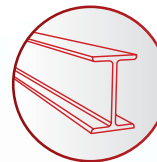
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TOP COMPANIES CONNECT WITH THEIR EMPLOYEES

BY STACEY SCHROEDER, DIRECTOR, NTMA WORKFORCE DEVELOPMENT



Every year, the Plain Dealer (Cleveland's newspaper) evaluates the best workplaces in Northeast Ohio, based on independent survey results. I always read the results with interest, and wanted to share some of the trends at top companies in the area. This year, 247 companies with a total of 130,000 employees participated. What I found invigorating is that many of the attributes of these top companies can be replicated anywhere and at any type of company. I encourage you to take a look, and I welcome your thoughts and feedback!

The top companies shared the limelight because of a consistent theme: they treat employees with respect, make each employee feel valued, and create an inclusive, authentic environment that people want to be a part of. The companies are connected with the employees. It's more than a 'clock-in clock-out' job to employees. They know they are part of something bigger.

Top companies have strong values and ethics, and leaders genuinely care about their employees and take actions to make it easy for employees to do their jobs well. This means having open lines of communication, providing the right tools, resources and training, and ensuring that systems, processes and rules support the work that needs to get done.

These companies also provide flexibility, show genuine concern about employees and have leaders that inspire trust, confidence and commitment. Employees feel that their job is meaningful, and that they are encouraged to share new ideas and different perspectives, and to learn and grow.

If you think about it, these are all

ways to describe company culture. Culture exists in every company – the question is whether your company's culture is intentional or accidental. Some experts assert that culture might be the only sustainable competitive advantage today and in the future. A positive company culture is one in which employees are engaged. They feel empowered to give their best, they want to stay, and they would recommend your company to others.



To make sure your company is a coveted place to work and can attract and retain top talent – try asking yourself some questions. What attributes define your company's culture? How do you know? Is this the culture you want for your company? Is your culture pushing your business objectives forward, or holding progress back?

Some of the things that employees say about these top workplaces are about the leader – the people in charge are humble, they worked their way to the top over time, and they remember and understand what it's like to be in more entry-level positions. The leaders trust employees to make decisions and solve problems without micromanage-

ment. Employees feel that they can be themselves and achieve their goals – they feel supported. Employees shared many emotional examples of how employers have stepped up during tough times to take care of employees and take care of their company.

Top employers shared some of their tactics – they aggressively pursue talent, they check job boards, they look for talent at local schools and they welcome people looking to make mid-career

switches. They ask themselves those questions about culture, and take actions to improve it if they don't like the answers they get.

What I realized as I read the survey results is that all of things employees love about these top workplaces are things that I have seen at many NTMA members' companies. The NTMA is a family, and each of you shows your dedication and commitment to your family and your company every day. I hope

that you take some time to ask yourself those questions about company culture, and reaffirm that you're doing what's needed to drive the culture you need for the results you want. There is more visibility and transparency than ever – people talk, they read reviews, and they listen to their family, their neighbors and others in their community. You are in a position to make your company culture exactly what you desire – and reap the benefits of an engaged, committed workforce.



The Savings with Heartland Hire's Work Opportunity Tax Credit Program

Approximately 25% of all employees in the US qualify their employers to receive federal tax credits worth \$2,400 to \$9,600 per new hire. There is no cap on the amount of tax credits that an employer may earn, so as your business grows, so will your savings.



Tax Savings Assuming You Earn \$2,400 in Credits Per New Hire



1 New Hire	x	\$2,400 Tax Credits	=	\$2,400 in Tax Savings Per Year
5 New Hires	x	\$2,400 Tax Credits	=	\$12,000 in Tax Savings Per Year
10 New Hires	x	\$2,400 Tax Credits	=	\$24,000 in Tax Savings Per Year
25 New Hire	x	\$2,400 Tax Credits	=	\$60,000 in Tax Savings Per Year
50 New Hires	x	\$2,400 Tax Credits	=	\$120,000 in Tax Savings Per Year
100 New Hires	x	\$2,400 Tax Credits	=	\$240,000 in Tax Savings Per Year

TRENDING NOW: APPRENTICESHIPS

BY STACEY SCHROEDER, DIRECTOR OF WORKFORCE DEVELOPMENT, NTMA



The Apprenticeship Task Force. Updates to the Perkins Career and Technical Education bill. The National Council for the American Worker. Pledge to America's Workers. These are just a few examples showing apprenticeships' resurgence in popularity. I don't know about you – but I find it very exciting!

The US Department of Labor shared that the US has seen 42 percent national apprentice growth since 2013! Of the more than 500,000 apprentices in registered program, 35 percent are in manufacturing, according to IndustryWeek. Over 300 colleges have partnered with employers in the Registered Apprenticeship-College Consortium, which allows students the opportunity to translate apprenticeship experience and education to college credits towards a degree.

Apprenticeships might not feel 'trendy' but just like with fashion, culture and so much more – what's old can become new again. The shortage of skilled workers is impacting nearly every business owner in our industries, and it's going to take a mix

of large-scale and small-scale actions and commitments to drive true change.

Apprenticeships are a proven way to reach comfortably middle-class wages – without the debt associated with higher education. The typical apprentices in the U.S. is currently 28 years old – and can expect to make about \$12 - \$22 / hour to start, depending on the specific program they pursue. The average wage for a journey worker varies based on geography, complexity of the products, and years of experience – the national mean wage is about \$50,000, not including overtime, profit-sharing, bonuses and benefits!

The word 'apprenticeship' itself is not necessarily 'on-point' with today's younger generations. Some alternative words to try include internships and mentorships – lots of similar aspects, and recognizable terms to get students and parents interested.

People want to be successful – they want



to feel secure. Apprenticeships are a great approach to building skills and experience in your current and future workforce, while providing the individuals with a living wage and good benefits, concrete skills, and a pathway to an exciting and meaningful career.

I encourage you to join the momentum! Last month's Record had many great stories from member shops around the country – they all would welcome a call or email from a fellow member looking for advice on starting or reinvigorating an apprenticeship program. The NTMA staff is also here to support you – please reach out anytime.



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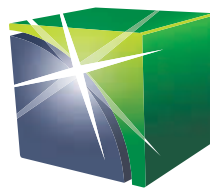
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BETAR, INC.: FIFTY GOLDEN YEARS OF SUCCESSFUL DRILLING

When John Lohse assumed sole ownership of Betar, Inc. in 2008, he knew it was time to take the company national. Since then, Betar has become the go-to specialty firm for deep hole drilling, gundrilling and honing, thanks to a well-executed growth plan that includes enhancements to the company's physical plant, workforce and marketing. Now celebrating its fiftieth year in business, Betar is poised for continued growth and success.

"I joined NTMA and began attending national and local meetings after my last partner retired. We had all the right equipment and people, and it was time to go big," says Lohse, who joined Betar in 1994 after a 15-year career with Turner Construction in Chicago.

In 2012, Lohse moved Betar to Somerset, New Jersey from a low-lying location in Hillsborough which flooded three times between 1997 and 2011. In Somerset, the company doubled its space and increased productivity by 35 percent. "This is a better physical layout for efficiency," explains Lohse. "We have two five-ton cranes, and the capability to drill precise holes in diameters from 0.078 inches to 3.500 inches, up to 15 feet deep, into virtually any material."

EXACTING PRECISION FOR ANY QUANTITY

The jobs handled by Betar are uniquely created for each customer and often not suited to mass production techniques. Many of Betar's projects involve just one or a handful of objects that will be used in a customer's manufacturing process, or in a unique piece of equipment. For this reason,



having master machinists operating precision equipment often takes precedence over robotic or CNC techniques. Still, each piece is machined to extremely tight tolerances, and customers know Betar's accuracy is dependably precise.

Betar's customers include companies in the aerospace, military, medical, agricultural, transportation, energy, machine tool, nuclear and pharmaceutical industries.

CULTIVATING TOMORROW'S WORKFORCE

"There is a 20- to 30-year labor gap in manufacturing these days, due to retirements and not enough younger people seeking jobs in manufacturing," Lohse says. "So, we have been lobbying the federal and state governments about our problem."

This concern led Lohse to work with New Jersey Assemblyman Andrew Zwicker and Raritan Valley Community College President Michael J. McDonough, to encourage community colleges to teach the

trades. Lohse serves on Raritan Valley's board for advanced manufacturing. "I helped develop the manufacturing curriculum and have the opportunity to meet potential new employees who excel in the college's Advanced Manufacturing program," Lohse added.

As part of its fiftieth anniversary celebration, Betar plans to hold an open house this fall for high school and college students to encourage them to learn about Betar and manufacturing career opportunities.

BACK OFFICE STRENGTH AT BETAR

In addition to enhanced production efficiencies, Lohse says, Betar has also improved its office operations. Payroll and job tracking are automated, and Betar obtained better insurance coverages at a better price by switching to a company that is focused on the manufacturing industry.

"Importantly, we have two new women in the office who practically run this place. They have stepped up and made me and the company better at the same time. They make it possible for me to focus on broadening my vision, which in turn has led to a steady increase in revenues over many years."

"The key is efficiency," explains Lohse. "We are 35 percent more effective with less people. That is amazing. We have kept our quality. We stand behind our work. We receive at least 75 percent of our work as referrals from existing clients and people I meet at trade shows who refer me to other people."

Quality, dependability, and reliability are three words used to describe Betar. These are the cornerstones which Lohse is using to propel Betar into the next 50 years and beyond.





IS THE TIME RIGHT FOR RESHORING?

New research - as well as incentives like lower corporate tax rates - suggest that it is

BY HARRY MOSER, PRESIDENT, RESHORING INITIATIVE



It's hard to pick up a newspaper or listen to a news report without hearing that U.S. manufacturers are reshoring production, and jobs, back to the U.S. It's a cause we have been dedicated to at the Reshoring Initiative. There are a number of reasons why we believe that 2018 is the right year for companies to re-evaluate their offshoring decisions. Among them are the reduction in U.S. corporate tax rates and regulatory costs and the approximately nine percent decline in the USD from Jan. 2017 to Jan. 2018.

Recent academic research provides useful detailed insight into how and why some organizations have reevaluated their offshoring decisions, leading to decisions to reshore. The results are generally consistent with the analyses of data collected by my organization, the Reshoring Initiative, based on a larger population of reshorers.

In a recent article entitled "Why in the world did they reshore? Examining small to medium-sized manufacturer decisions," John V. Gray, Gökçe Esenduran,

M. Johnny Rungtusanatham, and Keith Skowronski looked at four small-to-medium-size enterprises, or SMEs, with headquarters and demand in the U.S., that had moved their manufacturing operations from low-cost locations in Asia back to high-cost countries. Two of the companies are located in the midwest and two are in the west, with product categories ranging from power transmission equipment to measuring and controlling devices, to fabricated metal products to apparel. The authors found that these reshoring decisions are driven by factors beyond changing location-related costs.

The Reshoring Initiative and John V. Gray, one of the co-authors and a professor at The Ohio State University's Fisher College of Business, have discussed the reshoring phenomenon for years. This article is an effort to compare the results from the in-depth academic research of a small number of firms by Gray and his colleagues, and the larger-scale survey data collected by our organization. To differentiate between their work and ours,

any numerical results related to the work of the Reshoring Initiative are italicized.

LESSONS LEARNED

1. REMEDYING THE UNINTENDED CONSEQUENCES

SMEs are correcting the unintended consequences of initial offshoring decisions originally made by managers with limited offshoring experience. Focused on finding the lowest per-unit landed cost, these decisions were often made using overly simplistic heuristics, or shortcuts, to enable decision-making. In subsequent reshoring decisions, the SME's learned from experience and incorporated additional risk, cost and performance considerations into the decision-making process.

Negative events offshore: The SMEs made all of their reshoring decisions after experiencing negative events offshore, such as operational problems and intellectual property (IP) violations. The increased risk of these problems, and the associated potential costs, were not explicitly considered in the original offshoring decisions. Gray's research listed

9 real world examples of negative events offshore. They included:

- The use of unapproved suppliers without notice,
- The use of unapproved and different components in final assemblies,
- Delivery of finished products that were different than the samples provided,
- Suppliers unable or refusing to correct problems,
- Repeated poor-quality products,
- Brand damage due to poor quality,
- The need for third-party quality control inspectors not originally calculated into the original cost model,
- IP theft,
- Legal costs to address IP theft not originally accounted for.

Data collected by the Reshoring Initiative from some 700 companies across the U.S. from 2007 to 2016 is consistent with the study's detailed findings from its small sample of companies. Quality/rework/warranty was the #1 area of dissatisfaction with offshore, about 2/3 higher than #2, freight cost. IP risk was #8 but still mentioned by 10% of the companies that reshored. Other highly ranked factors were: total cost, delivery and inventory.

2. INCREASED AWARENESS OF LESS-QUANTIFIABLE FACTORS

When offshoring, SME managers often employed the lowest per-unit landed cost (LPLC) heuristic and put "a strong emphasis on the quoted price." When reshoring, SME managers consistently considered less quantifiable or less visible cost factors. Some of these examples included:

- Product quality, such as third-part inspector costs, rework of rejected products, time lost and inadequately captured opportunity costs.
- Brand damage and loss of reputation that can accompany poor product quality and loss of quality control.
- Supply chain and operational problems that are difficult to quantify such as port strikes that require "what if" advanced planning.
- Increased cost of responsiveness to market-driven product design changes due to physical distance. SMEs stated that changes offshore could take as many as 16 weeks as compared to a couple of days locally.
- Reduction of supply-demand mis-

match responsiveness emerged as a key factor for design flexibility and lead-time reduction.

- Harming of R&D productivity: Firms found that as the distance from their base operations increased due to offshoring, it was more difficult to maintain the relationships required for innovation, especially for SMEs lacking globally dispersed R&D and engineering functions. In "Producing Prosperity: Why America Needs a Manufacturing Renaissance," Harvard Business School's Gary P. Pisano and Willy Shih argued that innovation declines when manufacturing and engineering are separated.

In sum, decisions to reshore manufacturing operations, as compared to decisions to offshore, appear to incorporate a wider range of factors, many of which are extremely difficult to quantify.

These observations from the academic case studies are consistent with conclusions from the Reshoring Library and TCO user databases. We have found the following:

- Companies offshored primarily to re-

SEE "RESHORING" NEXT PAGE



"RESHORING" CONTINUED

duce their product cost, making decisions based on wage rates, manufacturing cost or ex-works price.

- A combination of accumulated offshore experience and offshore costs rising relative to domestic costs has driven companies to reevaluate their offshoring decisions.

- The distribution of Chinese offshore ex-works price as a percentage of U.S. ex-works price has a mode of about 72%. Approximately 25% of the offshore work would have a lower total cost if sourced domestically. Use of TCO can justify reshoring some work, but far from all.

- It is far easier to reshore work that is outsourced offshore than in-house offshore.

3. INDIFFERENCE TO ENVIRONMENTAL CONCERNS

Although SMEs did not take environmental impact into consideration in their decisions to reshore, they were well aware that manufacturing in the U.S. is substantially cleaner than in China.

Similarly, the Reshoring Initiative has found that green considerations were cited fifty times but came in as number eleven of the negative factors found offshore. The Initiative is developing a Corporate Social Responsibility Estimator that will help companies estimate the relative environmental impact of offshoring and reshoring.

4. GOVERNANCE STRUCTURE: LEVEL OF ADMINISTRATIVE CONTROL

Governance considers the level of administrative control of the operation that can range from complete (in-house, hierarchical governance) to intermediate (local production, close partnerships with suppliers, hybrid governance), to essentially no control (typical of offshoring, arms-length, market governance).

OFFSHORING AND LOSS OF CONTROL

Other research has shown location decisions often are conflated with governance decisions, the offshoring and reshoring decisions examined here being no exception. Partnerships typically involve extensive, often face-to-face, buyer-supplier interaction. Local production is expected to facilitate such interaction, permitting greater cooperation and collaboration between manufacturing and other functions.

- The original offshoring decisions did not appear to explicitly consider the governance implications of extending the

supply chain through offshoring.

- When offshoring, the SMEs shifted governance structures toward market governance (essentially no control / arms-length). After offshoring, they visited infrequently (primarily for auditing purposes) or not at all, often relying on an intermediary, or broker, to manage the offshore supplier. Thus, what was thought of as a location decision also was a governance decision.

- When reshoring, the SMEs moved away from market governance, with half of the reshoring decisions moving to in-house production.

- Even the reshoring decisions that did not include in-house production led to increased coordination and cooperation with domestic suppliers, along with increased control.

- Related to the above two bullets, firms typically reshored in the context of rethinking their supply chain structure and competitive priorities to take advantage of the reduced geographic and organizational distance to their suppliers. Thus, the decision was intentionally not just a location decision but also a governance decision.

- Selecting local suppliers enabled higher quality control and resolution of issues as they arose.

In sum, decisions to offshore, seemingly unintentionally, shifted governance towards market. Decisions to reshore tended to, more deliberately, shift the governance structure away from market governance.

About 70 percent of the publicly reported reshoring is in-house by the company that decides to reshore. This statistic is likely at least partially driven by the fact that in-house reshoring typically involves a new facility, and thus is likely to be written about in the press. Conversely, a change from an offshore to an onshore supplier may be seen as just another order and is less likely to be documented.

5. PROPOSITIONS BASED ON THE RESEARCH

Overall, the academic research found that SMEs, through their decision-making process, are remedying the unintended consequences of initial offshoring decisions made by managers possessing limited offshoring experience using overly simplistic heuristics. The researchers derived propositions related to SME reshoring decision-making. Here, managers at the SMEs focused on finding the

lowest per-unit landed cost (the aforementioned LPLC heuristic). Focusing on cost, managers often altered not only the geographic distance, but also the governance structure away to an arms-length "market buy", sometimes from a starting point of in-house production. This added the complexities related to outsourcing with those of offshoring. In subsequent reshoring decisions, they learned from their offshore experience and incorporated additional cost and performance considerations into the decision-making. The derived propositions are:

- Proposition 1: The more the original SME offshoring decision resulted in a move toward market governance (arms-length outsourcing), the more likely the SME is to reshore.

- Proposition 2a: When facing intense competition in per-unit landed-cost performance relative to competition in other performance dimensions, SMEs are less likely to reshore.

- Proposition 2b: When facing intense competition not directly attributable to per-unit landed costs (e.g., responsiveness), SMEs are more likely to reshore.

- Proposition 3: SMEs are less likely to reverse their reshoring decision and offshore (or vice versa) when the original decisions were made subject to the condition of high offshoring experience.

In some of the cases, managers with prior offshoring experience hired after the original offshoring decision was made were instrumental in making the case for reshoring.

The researchers also suspected managers considered per-unit landed cost the most valid cue when deciding from where to source their products, and chose the viable option with the lowest per-unit cost. Offshore operational challenges forced managers to recognize later that they had undervalued important risks and performance challenges.

The reshoring decisions were made with more analysis and included more factors. This learning through experience is consistent with the simple-rules paradigm proposed in 2011 by the researchers Bingham and Eisenhardt.

Announcements of reshoring and FDI (Foreign Direct Investment) of manufacturing jobs in 2017 totaled 169,000, bringing the total number of such manufacturing jobs announced to over 570,000 since 2010.

CONTINUED NEXT PAGE

MEET OUR NATIONAL ASSOCIATE: MAKINO



WHAT IS YOUR COMPANY SPECIALTY?

Makino is a global leader in machine tool technology. The company has a long history of introducing innovative solutions that boost productivity and profitability. By integrating visionary digital technology with premium performance machines, Makino helps companies fundamentally transform.

WHAT IS YOUR COMPANY HISTORY? WHEN/HOW DID YOU START?

Makino was established in 1937 by Tsunezo Makino in Japan, developing Japan's first numerically controlled (NC) milling machine in 1958 and Japan's first machining center in 1966.

WHO ARE YOUR CLIENTS? WHAT TYPE OF WORK SHOULD A COMPANY CONTACT YOU ABOUT?

Makino offers a wide range of the industry's most accurate and precise metal-cutting and EDM machinery, including horizontal machining centers, vertical machining centers, 5-axis machining centers, graphite machining centers, and wire and sinker EDMs. To maximize ef-

iciency of this equipment, Makino's engineering services can optimize processes across all industries. Makino also takes cost savings and throughput to another level with automation solutions that can be customized for any volume or setup.

WHAT COMPANY ACCOMPLISHMENT ARE YOU MOST PROUD OF?

Makino owners value their Makino machines. Makino has always been an industry innovator bringing new things to the market that will help manufacturers of all sizes grow and compete globally. We are widely known for the outstanding precision of our machines and the micron level of precision we have in our machine build/manufacturing processes.

WHAT SETS YOUR COMPANY APART?

Makino has a well-established reputation of product quality and precision and highly advanced technology development and application mastery. We have global operations with world-class manufacturing capabilities and a worldwide service staff.

WHAT IS YOUR COMPANY MOTTO?

Integrity is at the cornerstone of everything we do.

WHAT ELSE WOULD YOU LIKE OUR READERS TO KNOW?

Makino will be the most reliable partner for applying new technologies to highly focused manufacturing markets.



The rate of reshoring and FDI doubled in the fourth quarter of 2016 presumably due to anticipation of greater U.S. competitiveness following the election. The rate then increased again in the first quarter of 2017 and maintained that level throughout the year.

TRENDS MAKING RESHORING MORE ATTRACTIVE

At the Reshoring Initiative, we believe there are a number of trends that make reshoring today more attractive. Among them are the reduction in the corporate tax rate from 35 percent to 21 percent and the immediate expensing of most capital investments is one of the trends making reshoring more attractive.

Moreover, while regulatory reform has moderately reduced costs, it has also dramatically improved business confidence that regulations will not get worse. The USD is down nine percent against a market basket of currencies in the last year. Skilled workforce training and automation are increasing. In addition to these recent improvements in U.S. competitiveness, the long-term rise in offshore labor rates, especially in China, is closing the

cost gap.

I conclude this article with a quote from the research team's article:

"A strong manufacturing base is considered critical to innovation capability, and is seen as beneficial to the middle class, the economy, and national security. Commonly discussed approaches to stimulate manufacturing within a country include infrastructure investments, direct incentives, and operating cost reductions. The research suggests that aiding managers to accurately incorporate the challenges of operating offshore is worth adding to that list."

Author's note: For readers interested in comparing the cost of out-sourcing versus reshoring, the U.S. Department has created a resource called ACETool, which stands for Assess Costs Everywhere. The tool is designed to highlight, and in some cases, quantify the hidden costs of out-sourcing manufacturing. The OpLab Cost Differential Frontier Calculator hosted by the University of Lausanne, is designed to answer the question: "How much cheaper does a long-lead-time supplier have to be to compensate for

the increase in demand-volatility exposure?" Another resource is the Reshoring Initiative's TCO Estimator. This tool sensitizes firms considering offshoring to a myriad of easily and not-so-easily quantifiable factors when comparing onshore and offshore sources.

Harry Moser is the founder and president of the Reshoring Initiative. He can be reached at harry.moser@reshorenw.org.

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- GL and MFG E&O inside package
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CUSTOM TOOL'S QUEST TO AUTOMATE

BY BOB YOUNG, CUSTOM TOOL



Eight years after successfully introducing automation on the shop floor with turning centers, Custom Tool is in the final stage of integrating a material handling robot with a vertical machining center. The objective is clear: develop the same proficiency at running "lights out" production on a vertical machining center.

"One of the first goals we set when acquiring Custom Tool in 2010 was to improve efficiency in order to be more competitive and to maximize the revenue generated from our assets," said Gillen Young, company President. With the purchase of a bar feeder at IMTS in 2010, the journey began. The initial vision was a 2-axis lathe with the new accessory running production throughout the night. Now three turning centers run "lights out" production regularly.

This accomplishment didn't happen immediately. The team had to "buy into" the idea that machines can run unattended. In addition, the team had to overcome hurdles related to quality and tooling. After sharing ideas and concerns, team members' research generated solutions which turned hurdles into improvement objectives. As successes started to mount, attitudes changed from

skepticism to optimism.

Young shared, "Our team's top priority is making quality parts. The thought of running scrap was a barrier for them. However, with the assurance from management that our initial effort was as much an educational exercise as it was about running production, they embraced the challenge and started to focus on how to make it happen. We've seen a lot of growth within our team members through this effort."

Custom Tool took a very methodical approach to running production "lights out." It started with low risk parts. After the initial attempts, it became evident that tooling, tool life management, and quality inspection plans are critical to a successful "lights out" production run. An early discovery was that tooling had to demonstrate the capability to run for extended periods of time without offset adjustments. That required documenting tool life for the various tools being used and establishing limits for how long a tool would be allowed to run before adjustment or replacement. Quality inspection methods transitioned to include a statistical approach. As "lights out" production increased, the volume of inspections required each day



Clay Adcock is working to integrate Custom Tool's first material handling robotic cell. The Fanuc M10 will be paired with a Bridgeport V480APC to expand "lights out" machining capabilities.

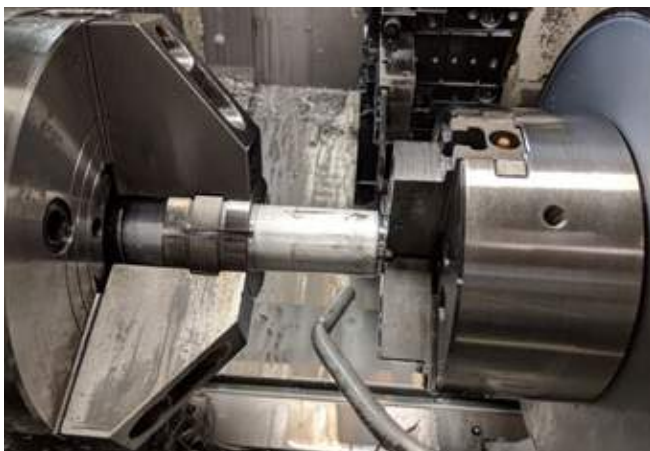
also increased. Automated inspection methods were introduced as part of the solution and improved the team's confidence in the quality of "lights out" production.

While production elements of the new processes were crucial, the big picture was important as well. How effective were these changes toward the company's goal of maximizing machine utilization? That answer was found by monitoring each machine's production throughout the day, week, month and year. Bob Young, Vice President, explained the approach, "The status of each work center throughout the course of a day tells a story. We started collecting shop floor data in 2011. Over time, this information helped guide our decisions regarding which processes were the best candidates for "lights out" automation. By analyzing the data, we were able to increase the probability that automation processes we introduced would be successful. That has allowed us to incorporate automation initiatives for parts we already run as well as parts we were bidding on." That approach has made the company more competitive and impacted management's decisions on capital spending.

Custom Tool has a broad view that automation is anything a machine can do that eliminates the need for human interaction.

An example would be deburring inside the machine rather than outside the machine. Another example is performing a secondary operation like cross hole drilling or bolt circle machining that might otherwise be done at a secondary station. Building on the success of automating processes for 2-axis lathes, the company began to invest in multi-function turning centers configured for maximum automation capabilities. These platforms allow more tasks to be completed within the machine cycle. Applying the same "lights out" process methodology, the result is more being done with each process both during the day and extending throughout the night.

"We believe in our approach," said Gillen Young. "In 2017, "lights out" production accounted for 38 percent of our overall production. This year's numbers are trending even higher. As our team continues to focus on making high quality parts, we will continue to invest in technology, invest in training for our team members and automate our processes making us more competitive in the global market."



Custom Tool's success with "lights out" production on 2-axis lathes gave them confidence they could achieve similar results with multi-function turning centers. These machines can complete secondary operations in cycle which increases automation.

THE CHALLENGE OF TARIFFS



U.S. manufacturers began 2018 filled with optimism. President Donald Trump had just signed historic tax reform legislation in December 2017, which greatly reduced burdens on small- and medium-sized companies, freeing up funds to invest in growing their businesses. Industry groups heralded record confidence levels among manufacturers and predicted an overall positive outlook for wage and job growth in the sector.

Unfortunately, by June the U.S. was engaged in a trade battle – marked by tit-for-tat tariffs between the U.S. and our trading partners – that threatens this positive growth.

President Trump campaigned on the promise to balance the trade deficit and is using tariffs to try and achieve his objectives. While the jury is still out as to whether the President's strategy will ultimately achieve his objectives, manufacturers are feeling the immediate impact of this trade war.

In April, the Trump Administration announced 25 percent tariffs on steel imports and 10 percent tariffs aluminum imports. These tariffs were initiated under Section 232 of the Trade Expansion Act of 1962 and, according to Administration spokespersons, are intended to shore up American metal manufacturing jobs and correct the long-standing trade imbalances between the U.S. and other countries.

The problem with this tariff policy is that metal producing jobs, the jobs protected by

the tariffs, make up just 10 percent of manufacturing jobs. The other 90 percent of U.S. manufacturers are metal consumers, and those businesses are already being hit hard by the tariffs.

Unfortunately, when tariffs are imposed on imported steel and aluminum coming into the country, the cost of all steel and aluminum products – domestic and imported – go up. This is because, with the price spike in imported products, the demand for domestic products goes up and domestic producers raise their prices, too. U.S. manufacturers who make parts from steel and aluminum face higher prices for these commodities while their overseas competitors pay global, meaning lower, prices for the same commodities. With higher prices in the U.S., customers decide to take their business to foreign competitors.

NTMA Chairman Mark Vaughn has spoken to several national media outlets in recent months and explained the impact of the steel and aluminum tariffs on his business. At the start of this year, Vaughn's Nashville-based metal stamping business stood to expand work for one of their biggest clients, the Swedish appliance manufacturer Electrolux. But, as rumblings began about tariffs, Electrolux changed plans, citing concerns about rising steel prices. Without this new business, Vaughn fears he may have to cut his workforce.

It is important to remember that tariffs are paid by U.S. businesses like Vaughn's

and, ultimately, by American consumers. As of this writing, the U.S. government has already collected some \$582 million from the Section 232 tariffs alone. This money, then, did not go into hiring new employees or investing in new equipment, but to the government.

And, of course, the consequences of tariffs do not end on our shores. Our trading partners, including Canada, Mexico, the EU and China have already retaliated – or announced plans to retaliate – by imposing billions of dollars of tariffs on American goods exported to foreign markets. The U.S. Chamber of Commerce is warning that American industries should expect some \$39 billion in damages just from retaliatory tariffs.

NTMA is a member of the Coalition of American Metal Manufacturers and Users, a broad – and growing – organization dedicated to raising awareness about the negative consequences of tariffs for U.S. metal consuming industries and American consumers. It is the aim of the Coalition to have the tariffs lifted as quickly as possible.

NTMA members have seen this scenario before, in 2002, when steel was locked out of the U.S. through the Section 201 tariffs. As the flow of global steel inside the U.S. dwindled, prices rose. Studies show that some 200,000 manufacturing jobs were lost due to the imposition of those 201 tariffs.

The Trump Administration has been a consistent champion for manufacturing, working to strengthen career and technical education programs, bolster investment and hiring through tax reform, and protect American jobs. But these tariffs are doing more harm than good. Unfortunately, while the president's trade strategy is based on helping U.S. manufacturing, the unilateral approach of imposing tariffs is creating significant challenges for American manufacturers. Metal-using U.S. manufacturers are losing business to overseas competitors who now have access to cheaper steel and aluminum. The Coalition of American Metal Manufacturers and Users are urging the Trump Administration to take a more holistic approach to fight steel and aluminum overcapacity and cheating in the system. NTMA members can learn more by visiting www.tariff saretaxes.org.



USING DESKTOP 3D PRINTING TO GET MORE OUT OF CNC MACHINES

3D printers can handle the small ancillary tasks usually assigned to the CNC mill, saving money and production time.

BY DANIEL LEONG, CONTENT ENGINEER MARKFORGED



The CNC mill is the foundation of most modern machine shops, and it's usually the tool with the most demands competing for its time. This means making tough choices when small-volume parts are needed. One-off jobs like fixtures and work-holding often take the mill out of production for revenue-generating parts.

Acquiring an additional mill for support work is usually not financially realistic. So, until recently, there wasn't a good solution to this problem, and this led to jobs being rejected for lack of CNC time or deadlines being missed and customers upset.

However, over the last few years, a solution has emerged: desktop 3D printers. New materials available for today's 3D printers are stronger and more capable. Increasingly, shops use an affordable desktop 3D printer to take on support jobs to free up CNC mills. With fast overall turnaround times and enough strength, stiffness and accuracy for many smaller jobs, the desktop 3D printer is quickly becoming a cost effective companion to traditional CNC machines.

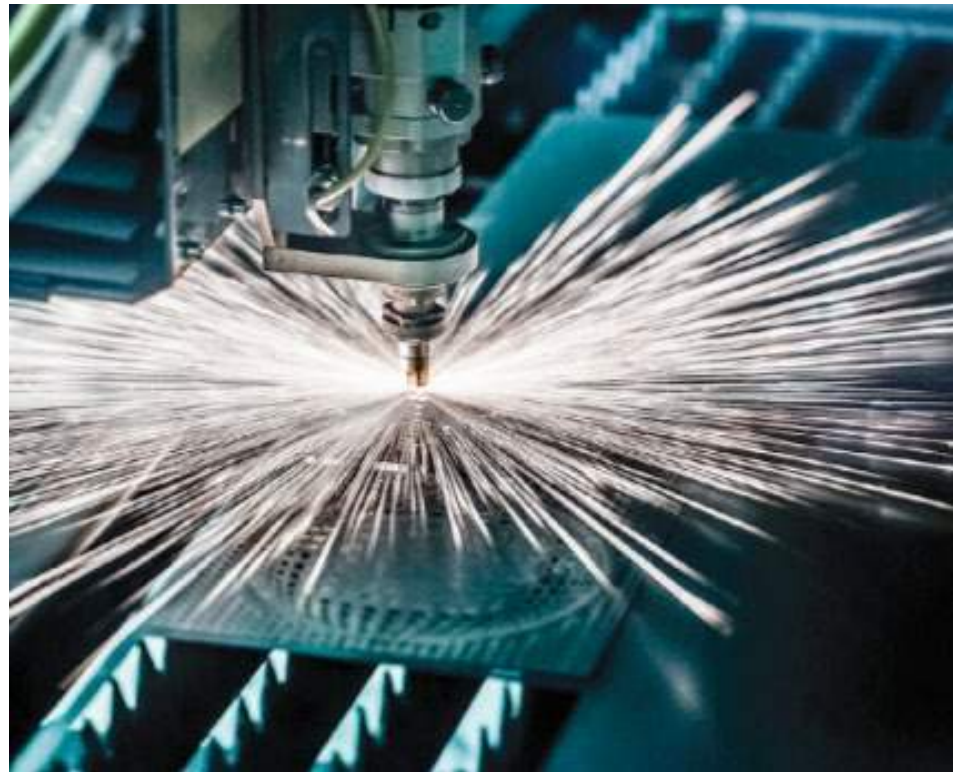
Scheduling jobs in a machine shop is a complex challenge. The best way to increase the return on investment (ROI) in expensive equipment is to keep that equipment busy doing productive work. Thus, the ideal CNC job is a higher-volume production order with little or no refixturing.

In real life, however, production interruptions are constant and often unavoidable. Many CNC tasks require custom fixturing pieces for efficient completion, and the CNC mills are usually the tool used to do this one-off, but necessary work. These jobs are just as critical as production, but generate no profit. Moreover, these ancillary jobs are often more complicated and take more time to program and machine than actually making the final parts.

In short, ROI and productivity, always tied to revenue and performance, are far better if production machines are producing. So if a shop can offload the one-off work from a CNC mill, that's a win.

3D PRINTING IN THE MACHINE SHOP

Aluminum is often the material of choice for prototyping and fixturing due to its low cost, high availability and ease of machining. Despite the fact that aluminum is often



many times stronger than what is needed for prototypes, machining plastic or something similar is often considered more difficult and not worth the time. Just choosing a plastic is complex enough, which is why it's generally considered more direct and efficient to go straight to aluminum.

The key factor for bringing 3D printing into the machine-shop ROI mix is that desktop 3D printers are designed to make it hassle-free to create plastic parts. For a 3D-printed object, the part is printed based on a CAD file; toolpaths needn't be set up in CAM programs. The part is then created on a machine that is smaller and less expensive than a CNC machine with minimal operator interaction.

Common 3D printable plastics are strong enough for a variety of prototypes, fixtures and one-off parts. There are also now more plastics that are strong, tough and stiff—and especially well-suited for checking shape and fit, and making fixtures for shimming, clamping and orientation. Furthermore, 3D printers make it easy to work with plastic.

That said, various 3D-printing processes have been available for over 20 years, yet they haven't made great inroads into plants and

shops. So, what has changed?

Accessibility and quality are key. Even in 2016, the accessible workshop or workgroup 3D printer was a new product category. An increasing number of 3D printer companies have also chosen to support shop-scale customers with offerings boasting ease of use, reliability and readily available technical support formerly reserved for industry 3D printers. These are not features of 3D printers for hobbyists or the consumer market. Hobbyist 3D printers appeared a few years ago, but these machines are finicky and not for the faint of heart—more time can be lost attending to the printer than saved by using it.

Perhaps most importantly, 3D printing materials are better than ever. Tougher ABS, nylons, composites and photopolymers have appeared at an accessible level, and it seems nearly every week, some company releases a new 3D printable material with specialized properties.

Today, if you can use CAD, you can use a 3D printer to do valuable work. If not, all is not lost, because CAD has become much easier to work with, and more accessible, too.

SEE "3D PRINTING" PAGE 26

Hard-to-machine materials.
Complex geometries.
Employee training challenges.

The realities of today's manufacturing floor require keen attention to constant process improvement.

Technological improvement comes through technical qualification and training. They're indispensable in securing the future of your company. HEIDENHAIN CORPORATION in North America provides you with technical training for 3- and 5-axis programming of machining centers. Our state-of-the-art training facility in Schaumburg, IL, provides programming simulators and high-end 5-axis machining centers, allowing you to apply what you learned on a real machine.

We also offer customized onsite training classes, focusing on your specific application and training needs, helping your team take advantage of all the innovative features your HEIDENHAIN TNC offers.

Your team will run circles around your competition, producing precision parts more efficiently — down to lot size one.



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"3D PRINTING" CONTINUED

3D PRINTING IN ACTION

The first step in designing a part for 3D printing is the same as designing it for CNC milling: Engineers use a 3D modeling program to construct a solid body. In many cases, the solid model designed for a machining process can be reused for 3D printing, although engineers experienced in 3D printing often make minor changes to ensure 3D printing is more efficient. After the design is complete, the model is commonly exported from the 3D CAD program in ".STL" file format, an industry standard.

CAM is not required in 3D printing. Instead, the equivalent of toolpath generation is performed by a program called a slicer. Nearly all professional 3D printers include easy-to-use slicer software. It slices the part into many discrete layers and then generates toolpaths and machine code, which is used by the 3D printer.

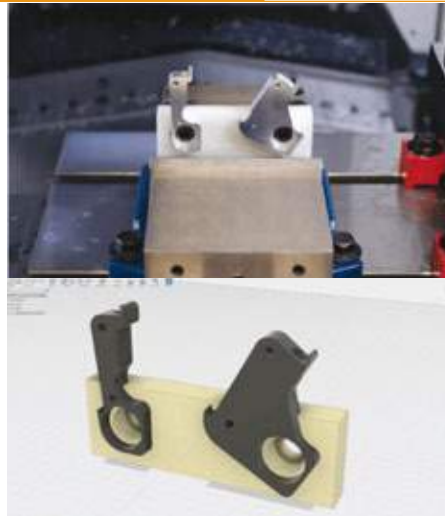
With some machines, the machine code is transported to the printer via a thumb drive or USB cable. Other machines are connected to computers using Wi-Fi or Ethernet over an office or shop network. Still others are internet-enabled and let users print from home or on the road.

Although there are many types of 3D printing processes, accessible professional 3D printers today use one or two fundamental types: thermoplastic extrusion or selective photopolymer curing.

Thermoplastic extrusion printers, also called FFF (fused filament fabrication) printers are essentially high-precision, robotic glue guns that melt and extrude both common and engineering thermoplastics such as ABS and nylon. Tiny extrusion nozzles moved about by X-Y-Z gantries form the shape of each layer. Photopolymer curing printers, called SLA (stereo-lithography) use lasers or light projectors to solidify pools of light-curing epoxy to repeatedly form the part's layers. Both techniques build up many tiny layers (often about 1/10 mm, or 4 thou per layer) until the three-dimensional part is complete.

Dimensional accuracy and resolution are related to printer technology and the manufacturer implementation, but most professional 3D printers are capable of a shop role. Here are some real-world examples of 3D printing giving CNC milling a boost.

Workholding – Soft Jaws: Some fixtures, including soft jaws, include curved or complex surfaces that typically require surface milling operations with a ball-nosed mill to create the desired geometry. Because 3D



The metal workholding jaws can scratch parts made of softer metals and other materials. The 3D-printed version uses softer metal jaws that will not harm the surfaces of the pieces they hold in place for CNC machining.

printing is an additive manufacturing process and requires no toolpath programming in a CAM package, curved surfaces are no more difficult to create than planar features. All geometry is handled by the software. 3D printers excel at producing these types of fixtures because the relative complexity of a part's geometry generally does not significantly affect the print time for fixtures or any other parts. Rob Bradshaw, head of Superstition Machine Works, uses a 3D printer to make soft jaws that hold complex shapes for drilling at difficult angles. According to Bradshaw, "I print things to save hours of time machining. And I'm drawing the soft jaws in the computer anyway. Not only do they look good, but they also worked perfectly. On one job, all 32 parts were cycled with no issues, with the last one fitting as well as the first."

Fixturing—Flats and Plates: Most fixtures (besides jaws) are largely flat. However, CNC milling them would include different operations that are time-consuming and may be difficult or tedious, especially on fixtures that must be reoriented several times to create off-axis geometries. Plate-like shapes are particularly well-suited to 3D printing's layered or additive manufacturing. Plates are shapes that can be printed quite fast and match up well with 3D printing techniques. They are also predictably strong in-plane.

Joe Walters, design engineer at Arow Global Corp., uses his team's 3D printer to create prototype extrusion profiles for rubber and aluminum extrusions, as well as to replace steel drill-jig components being used on Arow's manufacturing line. "We can now take a part that would have cost \$400, plus



A metal workholding piece (top) made by CNC milling was replaced with a 3D-printed version (bottom) that was much less expensive and could be created in two days instead of two weeks. The printed version is also lighter and easier to handle.

two-and-a-half weeks lead time of machining from one of our local vendors and print it over the weekend.

Gages and Quality Control: 3D printers can do more than produce parts. They can also simplify quality control (QC). Well-developed CNC machining processes are able to quickly churn out many copies of a part. However, as the volume of the job grows, it can be a challenge to spot defective parts and react to broken tooling which would minimize scrapped parts.

This is where inline QC becomes valuable and a good go/no-go gage can save time and money. Each project is different, but producing a gage may require a good deal of complicated machine fixturing or extensive multi-axis milling, both of which can tie up expensive CNC machinery for hours.

Many commercial desktop 3D printer can easily turn out parts with the tolerances needed by a good QC gage. Furthermore, since 3D printers require no complex fixture setups, creating a useful gage is as simple as designing it in CAD and sending it off to the printer—no operator monitoring required. Even better, 3D printing the gage frees up the CNC mill from a time-consuming task, thus letting a production machine do its intended job: producing.

Daniel Shepherd, Quality Manager at Turret Lathe Specialists, a high-precision job shop, uses 3D printed nylon gages to ensure stainless-steel fittings are machined with the correct radius. This makes Turret Lathe confident the fittings will withstand critical pressure applications used in the oil and gas industry.

"The 3D printed templates and fittings we used to make out of aluminum match the quality of the old aluminum tools, no question," says Shepherd. "We haven't had any issues with tools breaking, at least not any

sooner than they would have had they been made of aluminum. And knowing that we're saving on time and money, that just sweetens the deal."

Non-Marring and Modular Fixtures: Preserving the surface finish on parts that have just come back from a finishing house is not easy. This is especially true when a job dictates final machining operations or touch-up work on parts that have already undergone powder coating or anodization. Aluminum is often an inappropriate material for custom fixturing at this point; it's often harder than the surface finish material and can easily mar an otherwise flawless surface. At this stage, workholding fixtures are instead commonly machined from a relatively stiff, non-scratch plastic, such as acetal resin or UHMW-PE. But



3D printing can also make low-cost go/no-go quality-control gages such as this one, which is used to check the inner diameter of machined tube fittings.

producing these fixtures requires time on in-house CNC equipment, once again displacing production jobs.

Keith Durand, Senior Mechanical Engineer, Markforge, Inc., uses 3D printed modular fixtures to hold musical instrument parts for bending and machining operations in brass. The plastic surfaces of the 3D printed parts preserve the delicate surface finish of the instrument during production and assembly. He can also create curves and complex guiding surfaces that would be extremely expensive and challenging to produce with a CNC mill, requiring a machine with more than three axes and several resetting and refixturing operations.

"The most complicated bending fixture was for the F-branch," says Durand, as he recalls working on a French horn. "It had to be the right shape to bend things around, but had to have clearance so I could get the tube in here in the unbent configuration and out once the part was bent. 3D printing more or less makes it complexity-free. Machining this particular fixture, on the other hand, would have cost a small fortune."



Non-marring 3D fixtures are used to make and check tubing used on a French horn, ensuring the brass will not be marked up or marred.

SELECTING THE RIGHT MATERIAL

Although not every 3D printer will work with every material, here is a short list of materials that generally are considered suitable for effective shop use, and why. These materials can be 3D printed by machines costing between \$3,000 and \$30,000, with more expensive printers typically offering larger build volumes and a greater range of

be an engineering plastic. Its main drawback is that it produces a distinctive odor and potentially irritating fumes when melted. So when 3D printing with ABS, use adequate air filtration in office environments.

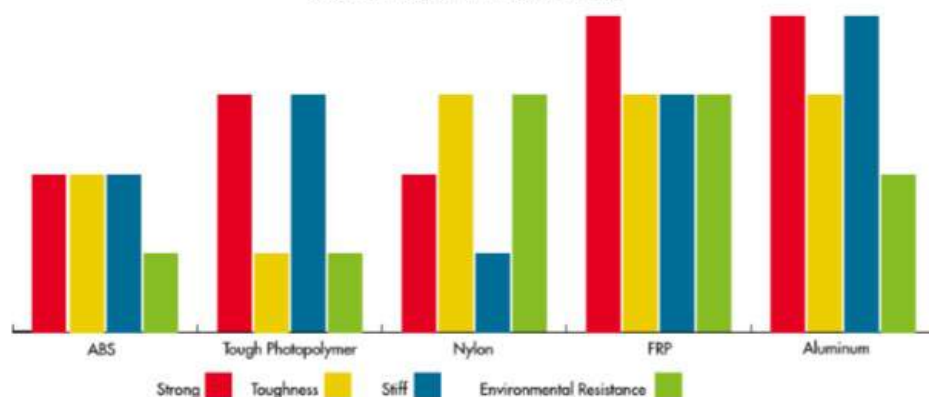
Tough Photopolymer is a recently developed material for photopolymer printers. Formerly, photopolymer prints were too brittle for workshop use, but these new materials, which include additives that reduce strength but increase toughness, are more suitable for engineering and workshop use, and have mechanical properties similar to ABS.

Nylon is readily available, although far fewer workgroup and workshop professional printer makers provide technical support for it. This engineering thermoplastic is among the most chemically resistant plastics and is well-known for toughness and self-lubrication properties. Nylons suitable for printing at room temperature are incredibly tough but not as strong as photopolymers.

FRP (fiber reinforced plastic) is becoming more widely available. These materials, which use chopped fibers to increase stiffness or continuous fibers to increase strength, are commonly used in injection-molding aerospace and automotive manufacture.

We have not included PLA (polylactic acid), the most common hobbyist material.

COMPARING 3D PRINTING MATERIALS



usable materials. Most fixtures used with 4- or 6- inch machining vises can be printed in a medium-sized build volume. Materials are not identified by manufacturer or by maker. New materials are regularly introduced into product lines and some printers use a wide range of third-party materials.

ABS (Acrylonitrile butadiene styrene) is the most commonly available plastic for workshop or workgroup printers. It is well-known and familiar, being the most common consumer plastic. ABS is not usually considered strong or durable enough to

It's a recyclable material favored for low cost and easy operation. Though quite useful for prototyping, it does not hold up as well as the other materials in load-bearing, fixturing or withstanding impacts.

In addition, various third-party materials and 3D printing machine manufacturers offer mixes of some of the above (e.g. ABS/polycarbonate), with blended characteristics that represent trade-offs between strength, toughness, stiffness and chemical properties.



MFG DAY – OPEN YOUR DOORS, OPEN THEIR MINDS

BY BILL PADNOS, NTMA, DIRECTOR OF YOUTH ENGAGEMENT

Modern manufacturing will generate 3.5 million high-skilled jobs in the next decade, with 2 million jobs going unfilled due to the current skills gap. The inability to meet labor demands continues to negatively impact companies like yours, and the entire nation. Each of us needs to take action!

Every day, you make decisions about how to grow your business, update your infrastructure and meet your customers' needs. Are you also taking the steps to ensure that your company has the workforce needed to accomplish your company's goals? Do the people in your community know what happens inside your facility, or do they just drive by?

Manufacturing associations, workforce development organizations and educational institutions have been working very hard and trying everything possible to convince students, parents, veterans, economically disadvantaged youth, diverse populations and anyone we can reach that working in industry is the right career choice. Through the NRL program, NTMA is engaging thousands of students each year in a job-driven, project-based STEM learning ex-



perience to promote pathways to careers in manufacturing. All of us are trying to make a dent in closing the skills gap, but in the end, it is all about you. Manufacturers are the only ones that can dispel the outdated

myths and misperceptions about industry. The first step in this process is to **OPEN** your doors, **SHOWCASE** what modern manufacturing is all about, **CONNECT** with future generations and **INSPIRE** them to join your team.

Since 2012, the first Friday in October has been known as Manufacturing Day (MFG DAY). This one day out of the year is designed to amplify the voice of individual manufacturers, empowering you to change the public perception of modern manufacturing. Last year, there were nearly 3,000 registered MFG DAY events across country. Were you one of the 60 NTMA member companies that hosted an event last year, or, were your doors closed?

This is your opportunity to inspire your next generation and celebrate the amazing things that you do on a daily basis. If Friday, October 5, 2018 does not work for you, any event happening in September or October can be tagged as part of MFG Day! You can plan your event on the date that works best for your employees, your local schools and your community. Your event can be open to the public or invitation-only. It is your call, just **PARTICIPATE**.

No matter the date, it's critical for your company's future to **OPEN YOUR DOORS** and **OPEN THEIR MINDS**. Show the world that you are investing in



ENGAGING MANUFACTURING'S NEXT GENERATION and register your event on both the NTMA MFG Day web-page, and the overall MFG Day website (a link to this is provided on the NTMA's website).

The NTMA has been a proud sponsor and supporter of MFG Day for five years and believes strongly that there is a direct connection between closing the skills gap and youth engagement. Hosting an event is simple, and the rewards are bountiful. Check out: <http://www.mfgday.com/mfg-day-resources> for an interactive dashboard showing real outcomes from students, educators, and employers that participated in MFG Day events.

We have a page on the NRL website that is dedicated to MFG Day resources, videos, templates and more! Please check out <http://gonrl.org/mfg-day-2018/> to see what's already out there.

Please plan on hosting an event at your company for MFG Day. It's up to all of us to change the perception of manufacturing, and get the next generations of employees, their families, their schools and their communities interested and engaged in the powerhouse of the American economy.



Contact Matt Gilmore at mgilmore@ntma.org or Bill Padnos at bpadnos@ntma.org for more information.



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CONSIDERATIONS FOR MACHINE MONITORING IN JOB SHOPS

BY JULIAN RENZ, HEIDENHAIN CORPORATION PRODUCT SPECIALIST, TNC PRODUCTS



The use of CNC controls in machine shops often turns complex monitoring work into simple and extremely accurate jobs. The newest controls now do more than ever and are worth reviewing. HEIDENHAIN TNC controls, for example, continue to set standards for high machining accuracy, user friendliness and superb path control. With the TNC 640, machining applications have even been extended to full turning capability on milling machines, and HEIDENHAIN is now also setting standards again in the area of machine monitoring and Industry 4.0.

For example, job applications can now be written on a HEIDENHAIN TNC with a control feature called "RemoTools" to automatically transfer tool data from a presetter (avoids manual errors, saves time). RemoTools is flexible in regard to applications that can be written, but a programmer is needed for the job. This is why HEIDENHAIN recently came out with StateMonitor, a machine monitoring software that can extract and visualize data such as utilization and operating mode of TNC controls. StateMonitor is basically plug-and-play, machines' IP addresses to be added, and the DNC interface (communication via Microsoft COM component) enabled.

For StateMonitor, no programming skills are required. The software also includes a messenger function, so that error messages can be sent to operators or maintenance immediately, reducing down times. Compatibility among controls was given a high priority in the development of StateMonitor and the result is that older TNC controls (at least 10 years back)

can be connected as well.

StateMonitor is an MDA software application (MDA = machine data acquisition) that is installed on a server in the company network. It captures a lot of important data ranging from the current machine status to machine reports and override settings all the way to usage history.



STATEMONITOR CAPTURES AND VISUALIZES THE FOLLOWING DATA, SUCH AS:

- Operating modes
- Program run time
- SIK number and software number
- Machine reports
- Override settings (spindle, rapid traverse, feed rate)
- Program status and program name, as well as the subprogram name if applicable

StateMonitor can combine machine signals and statuses (e.g., program end, machine standstill, errors or service warning) which can be sent to phones or tablets. Key metrics that

are calculated are the utilization rate = main usage time / busy time and availability = main usage time / scheduled busy time. Data can be exported and evaluated further.

User benefits include the fact that installation and start up is easy. No separate software or app is needed. And third-party service providers don't need to be consulted.

Configurations can be customized - no programming needed.

Furthermore, compatibility with MTconnect and OPC UA will be realized in 2018. This means that machines with different controls can be connected from a single source, without leaving the challenge of dealing with different industry standards to the machine shop. HEIDENHAIN's Connected Machining can be realized without purchasing additional hardware components.

State Monitor is developed on the basis of already existent PLM solutions by HEIDENHAIN, providing operators and engineers relevant documents in a fast way at different stages of the manufacturing process. Examples are the CAD viewer, the DXF converter and a second screen at the machine tool that allows access to emails or CAM software without having to walk back to the design office. In this regard, HEIDENHAIN offers Remote Desktop to flip between the control screen and other applications, and "Extended Workspace" to have two screens displayed at the same time.



HEIDENHAIN



MAJOR TOOL: SEVEN-TIME AWARD WINNER

Raytheon's Integrated Defense Systems business instituted the annual Supplier Excellence Awards program to recognize suppliers who have provided outstanding service and partnership in exceeding customer requirements. Award candidates are judged on certain criteria, including overall quality and on-time delivery. Major Tool & Machine (MTM) was one of 66 companies recognized by Raytheon's Integrated Defense Systems business for 3-Star honors. It marks the seventh year MTM was

recognized by Raytheon.

Major Tool & Machine (Indianapolis, Indiana) provides manufacturing, engineering, fabrication, precision machining and assembly services to a variety of United States and international customers. They are a registered small business with 400 employees and support several critical defense programs for Raytheon.



ACUTEC PRECISION AEROSPACE ANNOUNCES NEW VETERAN CAREER PROGRAM: ACUVETS

Acutec Precision Aerospace of Meadville, Pa. has announced their new Veterans Career Program, AcuVets. The AcuVets program is intended to assist service members transitioning to civilian jobs, while also offering information about careers within the aerospace industry. The new program offers qualified applicants unparalleled benefits, advanced skills training and advancement opportunities in a veteran-friendly environment.

"Veterans make excellent employees at Acutec because they effectively define their mission and goals and are invested in their work. They are many of our most successful machinists, inspectors, engineers and managers," said Elisabeth Smith, President and CEO of Acutec. "We welcome the opportunity to attract more veterans to our company and for them to start a long career at Acutec in a field that is vital to our national security—aerospace and defense parts and assembly."

AcuVets was designed with the service member's needs in mind, relying on direct input from veterans and best practices recommended by veteran transition resources. While the program will continue to evolve, the main features AcuVets offers include:

- **Aerospace Career Information:** Service members conducting a job search can access the AcuVets information page for career information on the aerospace industry.
- **Veteran Job Search Resources:** Acutec offers transitioning veterans resources such as military skills translator tools, interview coaching, and resume and cover letter templates.
- **Peer Sponsorship:** Newly hired veterans will be paired with other veterans at Acutec to assist with their transition to civilian sector and the Northwest Pennsylvania region.
- **Job Security:** The Aerospace Defense industry is poised for growth. Two million jobs will be available in the next decade.
- **Benefits Package:** Acutec offers one of the best benefits package in the region with perks that include employee ownership while not precluding qualifying veterans from their VA benefits.
- **Paid On-the-Job Training:** Acutec's Machinist Training Program allows transi-

tioning veterans with no previous aerospace experience the opportunity to learn these skills while being paid.

Because the aerospace industry often supports the United States in its defense work and missions, working in this career field can be a good culture fit as it allows veterans to continue to serve their country in a new capacity. In the past four years of company growth, Acutec has doubled the number service members with 50 currently among its ranks.

"Many of the attributes that make an individual successful in their military service directly transfer to the aerospace manufacturing environment: judgement, dependability, decisiveness, enthusiasm,

and initiative to name a few," said Lucas Warner, Team Leader of Acutec's ENF Cell. "I take great pride in knowing that the work I do at Acutec continues to support the troops through the manufacturing of defense components."

For more information on the AcuVets Program, please visit this link: <https://hubs.ly/H0d3ll40>



"NO PERSON IS AN ISLAND..."

BY DONALD LLOYD, THE LLOYD COMPANY



Whoever coined that phrase obviously never met the person who said, "it's lonely at the top."

Many times, top managers are faced with tough decisions. Oftentimes, there are so many factors to consider that the person at the top is the only one aware of them all... and their consequences. It seems there is no one to turn to for help.

More than once, a shop owner has been faced with a decision they've never made before. But, seldom is a decision faced that has not already been made by someone else before. In fact, most of the decisions a shop owner makes are also being made by others in their position.

The beauty of the NTMA is that we are all friendly competitors. Hundreds

of others are available to give you assistance and advice on important decisions! Some members can't wait until the next meeting to ask others how they handled similar situations.

The NTMA is made up of the strengths we build into it. So, depend on one another. If you have a tough decision or situation, call another member. You will be surprised by how valuable that input will be. You will also be amazed by how many others already find another's experiences helpful in making their own decisions.

It's "lonely at the top", but there are others who are also at the top. So, remember, "No person is an island" and the NTMA is there for you.



ALLIED MACHINE PARTNERS WITH LA/NTMA TRAINING CENTER

Allied donates tools and hands-on instruction to help reduce manufacturing skills gap.

SUBMITTED BY DEBORAH A. BELEW, PUBLIC RELATIONS / SOCIAL MEDIA & CONTENT COORDINATOR, ALLIED MACHINE & ENGINEERING

Allied Machine & Engineering of Dover, Ohio, a leading manufacturer of holmaking and hole finishing tools joins forces with the Los Angeles Chapter of NTMA (National Tooling and Machining Association) in an effort to provide top of the line resources and real-life precision machining expertise. In June, Allied donated several tooling sets to NTMA's LA training centers. The selection includes high-end cutting tools from their drilling, boring and thread milling product lines. In coordination with LA/NTMA board member Darin Martinez, President Brian Grigson, and executive directors Carey Knutson, Kaity Van Amersfort, and Norma Meza, the tools will be used in training demonstrations and available for student use. Nate Craine, Allied's highly trained regional field sales engineer, will be volunteering to conduct classroom demonstrations throughout the year at both the Ontario and Santa Fe Springs NTMA Training Centers of Southern California.

"I am excited to get our tools on the machines and demonstrate best practices for holmaking & thread milling in real-world scenarios," Craine states. "We're proud to partner with the LA chapter of NTMA which has been accredited by the NIMS (National Institute for Metalworking Skills) and is the largest of 33 NTMA chapters. I'm looking forward to working with current trainers Steve Bui, Ed McLean, John Templeton, and Steve Yackel and really appreciate

this opportunity." Mr. Craine will present an overview of the unique nature of holmaking in metal, demonstrations of their GEN3SYS XT Pro & Revolution drills, Wohlhaupter MultiBore precision boring tool system, and the AccuThread thread mill. He will also provide programs for threadmills and speeds/feeds for all Allied drills demonstrated.



Machines utilized in training curriculum include HAAS VF-2 & several manual drill presses with demos being run in 6061 aluminum. Class sizes range from ten to twenty students and provide the perfect environment for maximum participation. Check the NTMA Training Centers of Southern California website for class schedules.

Career opportunities in manufacturing are growing as the industry makes huge strides in advanced technology and product innovations. At the same time, baby boomers are retiring and manu-

facturers struggle to find qualified, job-ready machinists to fill the looming skills gap. NTMA and Allied Machine both share a strong commitment to inspiring the next generation to think about manufacturing differently. Together, they share a passion to provide the most advanced tools and expertise available in order to offer the best machine

technology training for the 21st century. Through this generous tooling donation, live classroom demos, & the addition of Allied's unique knowledge of holmaking to supplement LA/NTMA's current curriculum, the two groups look forward to shaping the next generation of precision machinists.

That generation of machinists will need continuous training to remain competitively skilled in advanced machinery operation. With over 75 years of experience in the unique demands of holmaking, Allied Machine & Engineering stated they are grateful for

opportunities to share solutions with career centers, machine shops, and the manufacturing industry and appreciate partnering with groups like NTMA who are just as passionate about educating our future machining workforce.

For more information on the product donated please visit www.alliedmachine.com or call 330.343.4283.



GLOBAL SHOP SOLUTIONS CELEBRATES 25-YEAR ANNIVERSARY OF ERIKA KLEIN, VICE PRESIDENT OF R&D

SUBMITTED BY KATHRYN HOSFORD, GLOBAL SHOP SOLUTIONS

Global Shop Solutions is proud to celebrate 25 years of ERP software excellence under the leadership of Vice President of R&D, Erika Klein.

As the daughter of Dick Alexander, founder of Global Shop Solutions, Klein has lived and breathed the company since she was a young girl. From joining her parents at the office after school, to running our R&D department of nearly 100 people, Klein has been a visionary in 40+ years of company success.

Klein's journey as an employee started in Global Shop Solutions service department helping customers navigate our software, but she quickly transitioned into the role of Chief Software Designer. During her tenure, she has led the release of dozens of applications that simplify manufacturing for our customers.

Each of the products released in the past two decades – Business Intelligence, CRM, Quality Control, FLOOM, Document Control™, Advanced Planning & Scheduling, GAB, and Dashboards for Manufacturers – all have Klein's design and manufacturing leadership. Every application within the sys-

tem has made a direct impact to customers resulting in a better return on their investment and simplified manufacturing.

"Twenty five years ago my remarkable sister, Erika Klein, walked through the doors of Global Shop Solutions for the first time as an employee," says President and CEO Dusty Alexander. "Since then, she's grown to lead our R&D department managing four teams and nearly 100 people earning the respect and admiration of all employees. Our manufacturing customers around the world benefit from her ability to lead others as her team brings great products to market every day."

ABOUT GLOBAL SHOP SOLUTIONS

Since 1976, Global Shop Solutions has been the exclusive provider of the One-System ERP™ Software designed to simplify your manufacturing. The efficiency delivered through their ERP software provides real-time inventory accuracy, improved on-time delivery, lower administrative costs, increased sales and improved customer service. Real-time data with high-level accuracy empowers business leaders to be proactive in their decision making. Global Shop Solutions' customers enjoy a significant ROI to their bottom



line. Headquarters in The Woodlands, Texas includes a state-of-the-art R&D facility and their Global Shop Solutions University training center. Through its offices in the U.S., Mexico, Indonesia, Singapore, Australia, New Zealand and the United Kingdom, it maintains its place of prominence in the ERP manufacturing software industry.

For more information, please visit www.globalshopsolutions.com.



IT ALL ADDS UP: THE OPERATIONAL COSTS OF MOVING FREIGHT

BY JERRY SPELIC, PARTNERSHIP

Moving freight is getting more difficult, and therefore, more expensive. If you've ever had sticker shock from a freight quote, you're not alone. There are a lot of cost factors that go into the price you pay to move freight, and it's important to break them down so you can ship smarter.

Every LTL or truckload freight shipment has fixed and variable costs that are calculated into the rate you pay to ship your freight. Let's start by looking at the fixed costs.

FIXED COSTS:

- **Truck Payment.** Owned or leased, drivers and operators have the expense of their equipment (trucks and trailers) to consider when quoting your freight. New trucks can be leased for \$1,600 to \$2,500 per month and used trucks can be leased for \$800 – \$1,600 per month; a new truck can be purchased for



\$2,250 a month (purchase price of \$125,000 with 5-year financing). On average, truck payments are 16 percent of the cost of moving freight.

- **Insurance.** The FMCSA requires individual owner-operators to carry a minimum of \$750,000 to \$5 million in liability coverage. On average, liability and damage insurance can cost between \$6,000 – \$8,000 per year, with newly-granted authorities typically paying between \$10,000 and \$16,000 their first year. Truck insurance accounts for 5 percent of the cost of freight shipping.

- **Driver Salary.** This is the largest operating cost of moving freight. Commercial truck driver salaries are based on the distance driven, and although drivers spend a lot of time in traffic, at the dock being loaded or unloaded, etc., their operating costs are only derived from miles traveled. With an average salary of \$78,200, driver pay and benefits accounts for 43 percent of operational costs.

SEE "PARTNERSHIP" NEXT PAGE

"PARTNERSHIP" CONTINUED

• **Office and Overhead.** This fixed cost includes a building lease or mortgage, and includes electric, phones, internet, computers, and office support. These costs can vary widely.

• **Permits and Licenses.** Permits and license plate costs account for \$2,300 annually, or 1 percent of operational costs.

VARIABLE COSTS:

• **Fuel.** The second largest operating cost of moving freight is diesel fuel. A commercial truck can easily consume 20,000 gallons (\$64,000) of diesel fuel per year, accounting for 21 percent of operational costs.

• **Tires.** Retreaded truck tires are less expensive than new tires and cost on aver-

age \$250. Annual tire expense accounts for \$3,600, which is roughly 2 percent of operational costs.

• **Maintenance and Repairs.** Trucks need constant maintenance and do occasionally break down. Issues with air lines and hoses, alternators, wiring, and brakes are all common in commercial trucks, and can cost \$17,500 annually or 10 percent of operational costs.

• **Meals.** The truck isn't the only part of LTL and truckload freight shipping that needs fuel! 10 meals a week at \$12 each equals a meals expense of \$6,500 a year.

• **Tolls.** With nearly 5,000 miles of toll roads in the US, chances are good that your freight will be traversing at least one of them,

and this will be factored in your cost. For example, a load moving from Chicago to Baltimore will encounter toll roads in Illinois, Indiana, Ohio, and Pennsylvania, costing \$225.75. Sometimes a carrier can avoid toll roads, but this will frequently increase the number of miles driven, which also increases your cost. On average, tolls add \$2,500 a year, 2 percent of the total cost of freight shipping.

• **Coffee.** Did you know that truck stops sell more coffee than convenience stores? The average commercial truck driver spends more than \$600 a year on coffee. Its effect on cost is negligible but thought it was interesting!

• **Profit.** Remember, freight carriers are in business to make a profit. Owners, operators and drivers are funding their kids' education or dance lessons, paying their mortgages, and buying food and necessities, so please don't expect them to move your freight for free.

There are also many miscellaneous items that can factor into overall freight costs:

• **Electronic Logging Devices (ELD),** which have decreased driver productivity approximately 15 percent. When drivers spend less time driving, transit times increase and drivers move fewer loads, which pushes costs up.

• **Telematics services,** such as vehicle and trailer GPS tracking.

• **Driver turnover;** not just the cost of recruiting and training, but also the opportunity cost of empty trucks not hauling freight because they have no drivers.

• **Finding loads** to move can take up a sizable chunk of every day. Every hour spent not driving loaded miles is an hour a driver isn't making money.

The bottom line: a lot of factors go into the cost you pay for LTL or truckload freight shipping. The costs listed here are conservative and are probably on the low end, so your costs may be higher.

The struggle is real: moving freight is getting more difficult and more expensive. By understanding the various costs that go into each and every LTL or truckload freight move, you are better informed so you don't experience sticker shock next time you get a freight quote.

PartnerShip is an NTMA affinity partner—prepared to help members navigate rising freight costs and other tough shipping issues. Visit www.PartnerShip.com/54NTMA for more information or, call 800-599-2902, or email sales@PartnerShip.com.



Your Shipping Connection

HEIDENHAIN

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FALL CONFERENCE 2018

OCTOBER 23 – 26 • DENVER, CO



NATIONAL TOOLING AND MACHINING ASSOCIATION

FEATURED SPEAKERS

CAITLIN ANDREWS

Wednesday, October 24 • 10:00AM - 11:00AM | 3:15PM - 4:30PM

Caitlin Andrews has a decade of experience in strategic communications. Her focus is on the design and implementation of comprehensive, multi-platform communications campaigns for a range of companies and associations in various sectors, including manufacturing, consumer products, national security, healthcare, energy and the environment. Caitlin leads the Policy Resolution Group's digital communications program, providing comprehensive brand development counsel, including sophisticated social media management and its use for effective advocacy. Caitlin was recognized by PR News on their list of 15-to-Watch in 2011.



JOHN GUZIK

Wednesday, October 24 • 10:00AM - 11:00AM

John Guzik is a founding partner of The Franklin Partnership with over 20 years of Capitol Hill and campaign experience. Previously, John served as Chief of Staff for Ways and Means Chairman Dave Camp. He was the top legislative strategist working on tax, trade, health care, transportation and agriculture issues. John also works closely with the Senate Finance Committee on health care, tax, trade and many other issues important to his clients.



OMAR NASHASHIBI

Wednesday, October 24 • 10:00AM - 11:00AM

For nearly ten years, Omar Nashashibi has worked with clients, members of Congress, agency officials, public policy foundations, non-profits and media in Washington, D.C. A founding partner of The Franklin Partnership, Mr. Nashashibi works with members of Congress on behalf of his clients on a variety of issues from trade to federal funding opportunities to telecommunications.





PAUL NATHANSON

Wednesday, October 24 • 10:00AM - 11:00AM

With more than 25 years of experience in strategic, crisis and corporate communications, Paul Nathanson's focus is on reputation management, message development and implementation, public policy analysis, media relations and strategic counseling services for a range of U.S. and international clients. He assists clients in formulating arguments in persuasive ways and ensures that clients' views are heard and understood by their target audiences, including Members of Congress, policymakers, the news media and the public.

BRANDON DEMPSEY

Wednesday, October 24 • 12:30PM - 2:00PM

Thursday, October 25 • 9:00AM - 10:00AM

An adventurer, entrepreneur and father, Brandon is a serial entrepreneur and driving force behind his marketing firm goBRANDgo!, specializing in outsourced marketing services for privately held \$10-100 million growth oriented companies. Brandon is a featured thought leader in numerous online and print outlets, such as Forbes, Inc., and Huffington Post. When he isn't working, he spends his time training for Ironman triathlons and motorcycling through countries around the world. Brandon lives in St. Louis with his wife Adriene, their daughter and two dogs.



PETER ZEIHAN

Wednesday, October 24 • 2:00PM - 3:00PM

Strategist, Thinker, Futurist, Speaker, Zeihan's worldview marries the realities of geography and populations to a deep understanding of how global politics impact markets and economic trends, helping industry leaders navigate today's complex mix of geopolitical risks and opportunities. With a keen eye toward what will drive tomorrow's headlines, his irreverent approach transforms topics that are normally dense and heavy into accessible, relevant takeaways for audiences of all types. In his career, Zeihan has ranged from working for the US State Department in Australia, to the DC think tank community, to helping develop the analytical models for Stratfor, one of the world's premier private intelligence companies. Mr. Zeihan founded his own firm — Zeihan on Geopolitics — in 2012 in order to provide a select group of clients with direct, custom analytical products.

DEBORAH ELAM

Friday, October 26 • 1:00PM - 2:00PM

From graduate intern to GE's first-ever black female corporate officer, Deb dedicated her career to diversity, philanthropy and inclusion. She oversaw efforts to embrace diversity in order to create an environment where GE employees are able to thrive and contribute to the company's success in the global economy. Her experience spans across multiple organizations within the corporation. After thirty years with the multinational conglomerate, Deborah Elam has retired from her dual role at General Electric as Chief Diversity Officer, as well as President of the GE Foundation. Most recently, Deb launched Corporate Playbook, a business consulting firm in which she serves as President and CEO. The firm coaches organizations to elevate diversity, inclusion and philanthropy. Its specializations include executive development, strategic solutions and the empowerment of women to shatter the glass ceiling.



GENERAL SESSIONS



IMPACT OF 2018 ELECTIONS ON THE TRUMP AGENDA

Wednesday, October 24 • 10:00AM - 11:00AM

The Franklin Partnership & Bracewell Update: Omar Nashashibi, John Guzik, Caitlin Andrews & Paul Nathanson

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NO ASSEMBLY REQUIRED: THE FUTURE OF GLOBAL MANUFACTURING

Wednesday, October 24 • 2:00PM - 3:00PM

Speaker: Peter Zeihan, Founder, Zeihan on Geopolitics

The world of manufacturing is an endlessly specialized venture, with most manufacturers sourcing components from scores of facilities across a dozen or more countries. But what if the ability to sail components from site to site became compromised? What if capital availability proves insufficient to update industrial bases as technology evolves? What if intermediate and end markets become less desirable – or less accessible? All that and more is about to happen, which signals the end of manufacturing as we know it. The successful manufacturers of the future will be those who can command access to raw materials, capital, labor and markets – all in the same location.



WORKFORCE DEVELOPMENT PANEL

Wednesday, October 24 • 3:15PM - 4:30PM

Moderated by: Caitlin Andrews, Director, Policy Resolution Group at Bracewell, LLP

Hear from a diverse group of educators, industry experts and NTMA members on the most pressing topic in today's shops – people. Our panelists will share best practices and lessons learned on engaging with your community to build the talent pipeline, attracting the best talent and creating a culture and environment that delivers results and keeps your top performers engaged.



HR SOLUTIONS CIRCLE

Thursday, October 25 • 9:00AM - 10:00AM

Facilitated by: Brandon Dempsey, Partner, goBRANDgo!

A collaborative group activity where each person states a burning issue or challenge; then each challenge gets its turn at the table for the group to help brainstorm ideas and provide advice on each problem. At the end, the group will have a table of ideas and solutions.

STRATEGIES TO ATTRACT AND RETAIN DIVERSE TALENT TO DRIVE IMPRESSIVE BUSINESS RESULTS

Friday, October 26 • 1:00PM - 2:00PM

A Q&A with Deborah Elam, former Chief Diversity Officer and President of GE Foundation at General Electric Company

Competition for trainable, technically skilled labor is fierce in the precision manufacturing sector. Innovative approaches to sourcing, onboarding and keeping diverse talent are more imperative than ever. In this session, you will gain valuable insights and learn how to develop your own playbook to attract and retain diverse talent in an inclusive environment. Don't miss out on the opportunity to leverage this key competitive advantage and growth enabler.



IGNITE SESSIONS

Sessions 1 & 2: Thursday, October 25 • 1:00PM - 2:45PM

6S/Lean – Creating a Workplace That is Safe, Clean, Efficient and Productive

What to expect:

- » Continuous Improvement Boot Camp – where to start and how to sustain

Team Engagement – Developing a Culture That Thinks and Acts Like Owners

What to expect:

- » Recognition and Communication – the secret ingredients of a healthy team
- » Leadership Development and Talent Succession – mentoring and coaching 101

Sessions 3 & 4: Friday, October 26 • 9:00AM - 10:45AM

Analytics and Information Management – Ensuring Our Data is an Asset

What to expect:

- » Strategies for cultivating and harvesting the data we already have

The Future of Manufacturing – Implementing the Essential Technologies

What to expect:

- » Technology Integration – trends in machinery, fixturing, tooling, and successfully integrating robotics and maximizing unattended operations

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SCHEDULE

Meetings Marked ♦ are open to Team Members or by invite only

Meetings Marked ♦♦ have limited lunches available and are first come, first served

Schedule Subject to Change

TUESDAY, OCTOBER 23

1:00PM – 5:00PM	Regiception: Sponsored by BIG Kaiser A reception and registration wrapped in one! Come register for all your Fall Conference sessions and events while enjoying a drink and networking with all the attendees.
4:00PM – 5:00PM	First Timer's Reception ♦
7:00PM – 10:00PM	2 nd Annual Cornhole Tournament - NRL Fundraiser

WEDNESDAY, OCTOBER 24

8:00AM – 5:00PM	Registration
8:00AM – 5:00PM	75 th Anniversary Gallery
8:00AM – 5:00PM	Exhibit Tables
8:00AM – 9:00AM	Continental Breakfast
7:00AM – 8:30AM	NTMF Board Meeting & Breakfast ♦
9:00AM – 10:00AM	General Membership Assembly - NTMA Update & Healthcare Update
10:00AM – 11:00AM	General Session 1: Impact of the 2018 Elections on the Trump Agenda The Franklin Partnership & Bracewell Update
11:00AM – 11:15AM	Networking Break
11:15AM – 1:45PM	Optional Activity: Coors Field Tour
11:15AM – 12:30PM	Board of Trustees Meeting
12:30PM – 2:00PM	Team Meetings with Lunch Budget & Finance Team Meeting ♦ Government Affairs Team Meeting ♦♦ Education Team Meeting ♦♦ Chapter Executive Team Meeting ♦♦ Emerging Leaders Session ♦♦
2:00PM – 3:00PM	General Session 2: No Assembly Required: The Future of Global Manufacturing Speaker: Peter Zeihan
3:00PM – 3:15PM	Networking Break
3:15PM – 4:30PM	General Session 3: Workforce Development Panel Moderated by: Caitlin Andrews
6:00PM – 7:00PM	NTMF Cocktail Hour
7:00PM – 11:00PM	75th Anniversary Awards Gala (Onsite) - Black Tie Optional

SPECIAL THANKS TO OUR SPONSORS

PLATINUM PREMIER SPONSOR LEVEL



SILVER SPONSOR LEVEL



BRONZE SPONSOR LEVEL



THURSDAY, OCTOBER 25

7:30AM	Optional Activity: NTMA 3 RD Annual 5K
8:00AM - 5:00PM	Registration
8:00AM - 5:00PM	75 th Anniversary Gallery
8:00AM - 5:00PM	Exhibit Tables
8:00AM - 9:00AM	Continental Breakfast
8:00AM - 9:00AM	Nominating Team Meeting & Breakfast ♦
9:00AM - 10:00AM	General Session 4: HR Solutions Circle Facilitated by: Brandon Dempsey
10:15AM - 11:15AM	Business Solutions Workshops: Financial Managers Solutions Sales and Marketing Solutions Workforce Development Solutions Safety Solutions Software Solutions
11:15AM - 11:30AM	Networking Break
11:30AM - 12:30PM	Business Solutions Workshops: Financial Managers Solutions Sales and Marketing Solutions Workforce Development Solutions Safety Solutions Software Solutions
12:30PM - 1:00PM	Lunch
1:00PM - 4:30PM	Optional Activity: Coors Brewery Tour
1:00PM - 1:45PM	IGNITE Session 1: 6S/Lean - Creating a Workplace That is Safe, Clean, Efficient and Productive
2:00PM - 2:45PM	IGNITE Session 2: Team Engagement - Developing a Culture That Thinks and Acts Like Owners
2:45PM - 3:00PM	Networking Break
3:00PM - 4:30PM	Industry Roundtables: Aerospace Tools, Dies & Molds Medical Precision Machining 1 Precision Machining 2
4:30PM - 5:30PM	PAC Reception
7:00PM - 10:00PM	Casino Night at the Wynkoop Brewery (Offsite) - GAAF Fundraiser

FRIDAY, OCTOBER 26

8:00AM - 11:00AM	Information Center
8:00AM - 11:00AM	75 th Anniversary Gallery
8:00AM - 11:00AM	Exhibit Tables
8:00AM - 9:00AM	Continental Breakfast
9:00AM - 9:45AM	IGNITE Session 3: Analytics and Information Management - Ensuring Our Data is an Asset
10:00AM - 10:45AM	IGNITE Session 4: The Future of Manufacturing - Implementing the Essential Technologies
11:00AM - 1:00PM	Team Meetings with Lunch WD Meeting ♦ Past Chair & Spouses Lunch ♦ ♦ Tech Team Meeting & Lunch ♦ ♦
1:00PM - 2:00PM	General Session 5: Strategies to Attract and Retain Diverse Talent to Drive Impressive Business Results A Q&A with Deborah Elam
2:15PM - 4:30PM	Optional Activity: A Tour of Hirsh Precision

REGISTRANT INFORMATION



National Tooling & Machining Association:
1357 Rockside Road
Cleveland, OH 44134

Name:	Additional Employee:
Company Name:	Title:
Title:	Email:
Email:	Phone:
Phone:	Spouse/Guest:
Company Address:	
City/State/Zip:	
Spouse/Guest:	

REGISTRATION FEES PER PERSON

Early Bird Registration: Thru September 30TH (Members Only)

- ☐ NTMA Member (1ST Co. Employee): **\$1,195**
- ☐ NTMA Member (Additional Co. Employee): **\$895**
- ☐ Corporate Rate (3 or More Employees): **\$895 each** ◆
- ☐ Emerging Leader: **\$895** ◆
- ☐ NTMA Member Spouse: **\$895** ◆
- ☐ First Timer Rate: **\$595** ◆
- ☐ Chapter Executive Rate: **\$495**

Standard Registration: After September 30TH

- ☐ NTMA Member (1ST Co. Employee): **\$1,395**
- ☐ NTMA Member (Additional Co. Employee): **\$1,195**
- ☐ Corporate Rate (3 or More Employees): **\$995 each** ◆
- ☐ Emerging Leader: **\$995** ◆
- ☐ NTMA Member Spouse: **\$995** ◆
- ☐ Affinity Partners: **\$995**
- ☐ Non-Member (1ST Co. Employee): **\$1,495**
- ☐ Non-Member (Additional Co. Employee): **\$1,395**
- ☐ Non-Member Spouse: **\$1,095 each**

- ◆ Spouse rate includes either the Coors Brewery Tour or the Coors Field Tour (Additional fees added to attend both)
- ◆ To qualify for the Emerging Leader rate, you must have previously attended an Emerging Leaders Conference
- ◆ Corporate Rate is for Member Companies only (Does not include National Associate Members)
- ◆ First timer rate is limited to one attendee per company and those who have yet to attend a National Conference

Networking and Optional Events

- | | | |
|---|---|---|
| <input type="checkbox"/> 3 RD Annual 5K (\$35) | <input type="checkbox"/> Coors Field Tour (\$25) | <input type="checkbox"/> NRL 2 ND Annual Cornhole Tournament (\$25 per person/\$50 per team) |
| <input type="checkbox"/> Coors Brewery Tour (\$20) | <input type="checkbox"/> Hirsh Precision Plant Tour | |

Teammate Name ☐ Find me a Teammate

PAYMENT INFORMATION

Method of Payment

- ☐ VISA ☐ Mastercard ☐ American Express ☐ Check

Credit Card Number:	Signature:
Expiration Date: CVV Code:	Total Amount Due:

Please send via email, fax or mail. If any questions, contact:

NTMA: Kristen Hrusch, Brittany Belko

Kristen Hrusch: khrusch@ntma.org

Brittany Belko: bbelko@ntma.org

1357 Rockside Road • Cleveland, OH 44134

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Ph: 216.264.2848 • Fx: 216.264.2840

KEYS TO SUCCESS FOR VENDOR COMPLIANCE AND INBOUND SHIPPING

BY LEAH PALNIK, PARTNERSHIP

Obtaining vendor compliance and maintaining smooth inbound shipping operations may seem like a tall order. However, with the right planning and follow through, it is achievable. By following these keys to success, you'll be on your way to reducing your freight costs, avoiding chargeback issues and creating efficient operations.

DEVELOPING AN EFFECTIVE ROUTING GUIDE

The very foundation of achieving vendor compliance is developing an effective routing guide. Routing guides provide shipping instructions to your vendors that help you gain control of your inbound shipments. They often include modes and carriers for specific lanes, as well as rate and service requirements.

In order to create routings that are best for your business, you'll need to consider several factors. Price, transit time and reliability are all important when selecting a carrier and determining how to have your product shipped. For different services and weight breaks, you want to designate a carrier that provides you with the best rate and can deliver your product in the time you need.

Conducting an in-depth analysis of your inbound shipments can be time-consuming but necessary when determining your routing instructions. This is where working with the right freight broker can make a huge difference. The broker you work with should provide inbound management services that help determine the routings that will be best for your business and will create the routing guide for you – saving you valuable time.

MAINTAINING GOOD RELATIONSHIPS WITH YOUR VENDORS

For smooth inbound shipping, you want to have a good rapport with your vendors. Like any other relationship, communication is key. For example, when you send your routing guide out to your vendors, it's a good idea to include a request for confirmation. However, you won't always receive one. If that's the case, following up and opening the lines of communication will be your best bet to ensure vendor compliance.

If your vendors aren't using your routing instructions after receiving your routing guide, you'll need to follow up with a call or email. When you have a good relationship with your vendor, you'll have

the right point-of-contact and will be able to resolve the issue quickly. If not, you could have a harder time achieving vendor compliance.

Maintaining a relationship with your vendors can be difficult and time-consuming.

This is another area where working with the right freight broker can make a difference. When selecting a freight broker, ask about experience in your industry. Quality freight brokers familiar with your industry will already have an established relationship with many of your vendors, which will help with compliance efforts.

PERFECTING YOUR ORDER FORECASTING

Managing your inventory can be challenging. But the advantages of forecasting and planning your orders ahead of time are too great to ignore. When you don't plan ahead and then need your product within a shorter time-frame, you will have to rely on costly expedited services. Spending the time up front to make sure your orders are placed with ample time will be better than spending the extra money in the long-run.

Also, with more lead time, you'll be in a better position to handle any issues that arise. For example, if your shipment gets lost or damaged in transit and you need your product immediately, you'll be out of luck. In that event, you'll need to file a freight claim which doesn't always guarantee compensation and is often a lengthy process.

If you're not able to place your orders ahead of time, it's a good idea to consider freight insurance. Unlike relying on carrier liability coverage, you won't have to worry about if the carrier is found liable or not and often times you'll get paid out much faster – making it easier to resume operations as normal.

CONDUCTING REGULAR REVIEWS FOR IMPROVEMENTS

Once you do have a routing guide in place and have vendor compliance, you can't just set it and forget it. It's best to review your routing instructions periodically

so that you're always getting the best rates and service possible.

You can choose to set aside a specific time each year to do a review. But if you make any changes throughout the year with your orders or any other factor that affects your shipments, you'll want to take that time to evaluate and update if necessary.

It's also important to stay on top of carrier rate increases, accessorial changes, and NMFC updates. These kinds of changes can have a significant effect on your freight costs and you'll want to make sure that you fully understand how these changes will affect your specific shipments. For example, carriers announce general rate increases every year and will present an average increase. If you simply use that average to judge how your costs will be affected, your budget will most likely be off. The increases vary greatly across the board depending on a number of characteristics, so it's important to evaluate them based on your specific shipments.

PARTNERING WITH THE RIGHT FREIGHT BROKER

The keys to vendor compliance and inbound shipping management are easy to master when you work with the right freight partner. PartnerShip can help conduct a complete inbound shipping analysis, create a routing guide, and send routings on your behalf for vendor compliance. Contact us today to get started or download our free white paper to learn more about managing your inbound shipments!



PartnerShip
Your Shipping Connection



NATIONAL TOOLING & MACHINING ASSOCIATION
1357 Rockside Rd.
Cleveland, OH 44134



THE RECORD

**Time to
Register!**

**75th Anniversary
NTMA Fall Conference**

Join us as we celebrate our diamond anniversary and recognize the people and companies who have shaped our organization and our industry. Built on tradition and pointed towards excellence-- this is an event you won't want to miss.

We'll see you in Denver, Colorado October 23-26, 2018.



NTMA