MINUTES

March 8, 2016
University of N.C. - Charlotte
Charlotte, N.C.
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# Attendance

## MEMBERS:

**Scott Hibbard (Chairman)**  
VP Technology & Product Management  
Bosch Rexroth – Electric Drives & Controls  
Hoffman Estates, Ill.

**Russell Reinhart**  
U.S. National Sales Manager  
Dormer Pramet  
Elgin, Ill.

**Douglas Watts**  
Chief Technical Officer  
MAG Automotive, LP  
Sterling Heights, Mich.

**Craig Ronald**  
Director, New Product Development  
The Gleason Works  
Rochester, N.Y.

**John P. Snyder**  
Sr. Mechanical Engineer  
ARDEC – Benet Laboratories  
Launcher Productivity & Sustainment  
Watervliet, N.Y.

## STAFF:

**Tim Shinbara (Staff Liaison)**  
VP-Manufacturing Technology  
AMT  
McLean, Va.

**Benjamin Moses**  
Technical Director  
AMT  
McLean, Va.
Minutes

Tour – University of North Carolina, Charlotte

If it moves, it’s mechanical. And if it’s mechanical, our faculty, students and graduates are involved with it. Mechanical engineering industries include motorsports, bioengineering, manufacturing, aerospace, power generation, automotive and computing. The career paths for mechanical engineers lead in many directions including design, construction, research, education and management. The national average starting salary for mechanical engineering bachelor’s degree graduates is $56,000 per year.¹

UNCC is one of the top 10 mechanical engineering programs by size with ~1000 undergrad students and 180 graduate students. There are five concentrations; Precision Manufacturing, Biomedical Engineering, Motorsports, Mechanics and Materials and Energy. There is a high level of industry engagement through senior design projects, NNMI partnerships and contract R&D.

The tour was led by Scott Smith (Chair of Mechanical Engineering and Engineering Science ksmith@uncc.edu) Additional faculty participating on the tour include:

- **Brigid A. Mullany**
  - Associate Professor of Mechanical Engineering and Engineering Science
  - bamullan@uncc.edu

- **Tony L. Schmitz**
  - Professor of Mechanical Engineering and Engineering Science Associate Chair for Graduate Programs
  - tony.schmitz@uncc.edu

- **Edward P. Morse**
  - Professor and Deputy Director Center for Precision Metrology
  - emorse@uncc.edu

Areas shown on the tour:

- Manufacturing Research
- Precision Manufacturing
- Precision Metrology
- Motorsports

Welcome and Introductions

The meeting was called to order at by the chairman. The group introduced each other. The AntiTrust Statement and AMT TIC Mission Statement was reviewed.

AntiTrust Statement

Trade associations have long been recognized as serving a valuable, pro-competitive and entirely lawful role in promoting the economic development and consumer welfare of our country. However, serious antitrust problems can arise if a trade association’s activities are not properly conducted. Accordingly, AMT assigns the highest priority to full compliance with both the letter and the spirit of the antitrust

¹ http://mees.uncc.edu/about-us
laws. It is thus vital that all meetings and activities of the association be conducted in a manner consistent with that policy.

AMT TIC Mission Statement
The Technology Issues Committee acts as the voice of the membership by providing input to the association on member needs in support of AMT’s products and services. The committee works with staff to develop, promote and implement programs and services relating to technology issues facing AMT members. The committee also assists AMT in meeting the objectives of the Board of Directors’ Strategic Plan.

AMT Update

Facilities
AMT Board has approved a pre-emptive move to a location nearby. This is ahead of a completed sell out of the new building. The move will improve the “sell-ability” of the building.

Operational Road-mapping
AMT’s current products and services are being reviewed and assessed. Based on this assessment, new products may be offered and previous products may be removed. This will be an ongoing process over the next few years.

October Meeting Minutes
Correction to the minutes; the dates on the TIC articles should be changed to 2016. A move to approve the October 22, 2015, meeting was made. The action was seconded. The meeting was then passed with no further discussion.

National Network for Manufacturing Innovation (NNMI) Review
Reviewed current NNMI.
https://www.manufacturing.gov/nnmi-institutes/

• America Makes
  o Additive Manufacturing
  o Youngstown, Ohio
  o https://americamakes.us/

• American Institute for Manufacturing Photonics – AIM
  o Integrated photonic circuit manufacturing
  o Rochester, N.Y.
  o http://www.aim photonics.com/

• Digital Manufacturing and Design Institute - DMDII
  o Digital Manufacturing
  o Chicago, Ill.
  o http://dmdii.uilabs.org/

• Lightweight innovations for Tomorrow – LIFT
  o Advanced lightweight materials
  o Detroit, Mich.
  o http://lift.technology/

• NextFlex
Department of Defense Request for Information

This roundtable discussion is about a request from the Department of Defense. The request is to understand the industry engagement and impact of an Advanced Machine Tool and Control System “institute.” The areas of interest within this institute could be:

- Robotic machining systems that reduce footprint and improve layout flexibility
- Integrated open source connectivity with improved machine interface and programming
- Integrated Sensors for closed-cycle control systems
- State-of-the-art Human Machine Interfaces (HMI) for intuitive, real-time analysis and optimization
- Integrated automation at multiple levels; design, process, materials, material-to-machine, machine-to-machine and machines-to-factory
- Fully seamless hybrid technology, including additive/subtractive manufacturing, fabrication and inspection
- Advanced tooling enabling faster cycle time, higher economy and better quality runs
- New materials for machines and beds that are lighter, cheaper, increased rigidity, stable through wider temperature ranges, dampen vibration, enable modular configurations and dynamic setups within a facility
- Low cost, high quality and highly accurate machines

Roundtable notes:

- What does advanced mean?
  - Advanced isn’t that relevant but a better question to ask is what is needed to push America’s competitiveness.
  - What in the machine tool is needed to leapfrog current research?
- There are no control systems designed and manufactured in the United States.
  - HAAS and Gleason are two examples to the contrary
- Might be better to shorten time to market
- Would a better goal/roadmap be first-part correct?
- RFI boundary
  - Solution can’t be use existing institute
  - Solution can’t answer all seven open questions
- Current RFI is missing the cutting tool industry
  - What are the benchmarks to define “advanced”?
  - Who is the customer for the institute?
  - Industry is the customer
  - Industry is too large of a customer since there are different end users
Defense is the customer for the RFI but industry will be the customer for the institute

- Consider adding cyber-security at the machine level

Five specific questions were discussed:

1. What is the motivation
   a. Need a substantial industry base
   b. There isn’t a large machine tool manufacturing base with a large R&D
   c. Cost of technology is a hindrance to implementation. End users are happy to have it but not pay for it.
   d. Technology enabling companies are not U.S.-owned
   e. Product pricing is based on market value and not cost-up process
   f. Difficult to sell advanced technologies in existing sales environment
   g. Skill may not be in the workforce to use advanced tech
   h. Previous U.S. machine tool builders are G.E. and Allen Bradley. Both are not machine tool manufacturers now.
   i. New technology will be more successful selling in the United States. Not much in Germany, very low success in Japan.
   j. Iterative technologies will be copied
   k. United States will have problems purchasing new tech if only one company has it. End user can’t get multiple bids.
   l. Price is a major factor for technology implementation
   m. Export control may be an issue when the market is saturated in the United States and can’t export
   n. Is there room for innovation around machine tools and not the machine tool itself?
   o. United States excels in making the interface more intuitive
   p. There is too much focus on the hardware side
   q. Application of machine tool is a gap
   r. Specific story: Company bought a machine with two spindles. The part process matched the machine but the company was not able to program both spindles so the operator had to manually index the part. This company will never buy this pricey machine because they feel its “wasted” money.

2. What is inhibiting the United States from being more competitive in manufacturing technology areas such as machine tools and control systems?
   a. Generally training is a checkbox. Not willing to make a long-term investment in training. Retaining highly trained people is a problem
   b. Where do people who don’t go to college go for skilled training? Vocational schools are gone. Mismatch of what is required to what the vocational school can provide.
   c. G-Code maybe too antiquated for today’s application. There are still terms such as rewind and punch.
   d. Machine tool for engineers is not good. Complexity of machines needs to match end user’s capability.
   e. We don’t understand the liability of the machine tool industry. Machine needs to work 99.999999999999% of the time.
   f. Currently can’t execute on current technology development. Need to focus on the middle of the industry. If you pay for a top down approach through technology, the infrastructure is not in place to make use of new technologies.

3. What evidence is there of critical technical mass for building upon existing regional hub(s) of excellence to create a national center of expertise as an MII?
a. If focused on the middle, a centralized center is not good. Need to decentralize and spread out.
b. Machine tool consumption is wide spread across United States. There are high concentrations but highly diverse.
c. Spoke and hub may be a better

4. What is the current state of U.S. manufacturing capability associated with this technology and what strategies may be required to ensure a successful domestic industrial base?
   a. R&D is a global function
   b. American engineers are more apt to use current “tools.” FEA, lasers ...
   c. U.S. manufacturers have lean staffing plans
   d. U.S. engineers are more innovative
   e. U.S. labor laws compared to EU laws. Easy to fire in the United States. EU more difficult.
       This doesn’t allow the workforce to be cultivated.

5. Within this technology focus area, what type of capital equipment is needed, how much of it is available to support a manufacturing commons, and where is it?
   a. Technology smaller than the finished good
   b. Finished goods are getting bigger and bigger
   c. Is there market there to match funding?

General end user trends
- End user may only look at machine and not entire process
- High volume of difficult alloys. Reduction of cast iron and steel volume
- Safety is seen differently in the United States compared to rest of the world

Top two topics for machine tools and controls
- HMI
- Hybrid technology, integrated sensors
Not on the list
- Workforce productivity
- Cybersecurity

Technology Department and IMTS Update

There are five main drives of the Technology department. They are Technology, Education, Nascent Products, Operations and Marketing. The TIC will be heavily engaged in Technology, Education and Nascent Products.

The department is undergoing personnel changes. Stephen LaMarca is a recent addition. Hilena is currently transitioning out of AMT during the month of March. The department is seeing two university interns and a full-time shared resource in the area of education.

IMTS has grown since 2014. The footprint has increased from 1.18 mil ft² to 1.21mil ft². The numbers of exhibitors are up to 1,282 from 1,276. The current wait list is 170 exhibitors.
**Tech Trends Update**
Software is in development. IMTS will be the initial reveal. TIC will contribute by participating in focus sessions and beta testing.

**MTConnect Update**
Main area of focus is [MC]^2 Conference

**Next Meeting**
Tentative date for the next meeting is June 14 (dinner) and 15 (meeting). Potential locations are Clemson and Coromant in N.Y.

**Actions**
Tech Trends beta testers are needed to better understand the customer needs. TIC members are requested to send contact information to participate in testing.

Revised TIC Views schedule
- AM material and equipment development
  - TIC Views article: Randy Gilmore (due 1/15/16)
- Platform for workforce development
  - TIC Views article: Steve O’Neal (due 4/15/16)
- Energy efficiency
  - TIC Views article: Scott Hibbard (due 3/15/16)

**Meeting Adjourned**
The meeting adjourned at 3:05 p.m.

Respectfully submitted,

Timothy J. Shinbara Jr.
Staff Liaison
Department of Defense Request for Information Submittal
A caveat: Given that cybersecurity for manufacturing is a much broader topic that could be of benefit to many manufacturing technologies and processes this topic should be considered as its own Manufacturing Innovation Institute (MII). This could be also be funded and further developed more appropriately through an existing MII like the Digital Manufacturing and Design Innovation Institute (DMDII), this response does not include nor weigh heavily on cybersecurity. That is not to say that the topic is unimportant or irrelevant to machine tools and control systems; quite the opposite is true. While machine tools and control systems are a central element in today’s cyber-physical security domain the cybersecurity topic is an all-encompassing one from devices (e.g. machine tools) on the shop floor (e.g. operational technology) to infrastructure (e.g. information technology) connecting the shop floor to the top floor (e.g. business intelligence).

AMT – The Association For Manufacturing Technology is submitting this document in response to RFI-AFRL-RQKM-2016-0009 Request for Information (RFI). AMT has been representing and promoting the interests of the U.S manufacturing technology industry for more than 100 years. Our U.S.-based member companies make, sell and service production technology and equipment – the machinery, devices, and digital equipment that enable U.S. manufacturers to make their products. AMT’s history with the industry gives us a unique view of the entire production process from the innovators, engineers and designers, to the builders, integrators and distributors, and finally to the users and service technicians.
Future advancements in manufacturing employ a holistic approach and include machine tools and controllers at the equipment level (e.g. capability, reliability), at the shop floor level (e.g. visibility, integrating the digital thread), and at the end-user level (e.g. intuitive interfaces and programming). We’ve seen macro movements around increased open architectures (from software to hardware); increased emphasis on human-to-technology engagement for increased usability; and a bias toward improving infrastructure solutions by lowering costs, reducing engineering burden, and attracting more creatively diverse talent to manufacturing. The parts are so inter-related and inter-dependent that essentially no one firm, association, or society could undertake such a task by itself.

As AMT, its Board of Directors, and AMT’s Technology Issues Committee (TIC) began reviewing the list of government potential topic areas, some key filters were identified to best prioritize topics for a national asset like an MII. Our members concluded that the best topic would: 1) have the highest impact on U.S. value-add manufacturing; 2) best position the industrial base for global competition; and 3) be most critical to achieving a more integrated, resilient manufacturing capability. The biggest challenges identified to achieving such manufacturing success were affordability (drastically reducing the risk and cost of development), leveraging existing (and attracting new) talent for the industry, and exploiting the prevalent tools/skillsets of the gaming and programming generations. After much debate and discussion, a capstone workshop event was held and an industrial case was developed to support Advanced Machine Tools and Control Systems as having the highest potential to: 1) impact value-add manufacturing; 2) improve the industrial base and global competitiveness (capabilities and capacity); and 3) best support the increased ecosystem of connectivity, visibility and integration.
The roughly $8 billion market of machine tools and control systems within the manufacturing technology sector are the crux of what drives the nearly $2 trillion U.S. manufacturing industry today (U.S. value-add) and will continue well into the future. The question is not if these are key enablers to improve the competitiveness of U.S. manufacturing, but how next-generation enablers will be developed, integrated, and deployed to do such.

Advancements in the machine tool and its control system require revolutionary changes to the human-machine interface (HMI), off-machine control systems (e.g. server-based) and the opportunity to integrate sensors, processing and automation throughout a manufacturing process; not just the machine. This creates an unprecedented potential to leap-frog the United States into the leadership role in advanced manufacturing. The United States is extremely competitive in innovation, in general, but especially in the application of technology. When advancements are coupled with more enriched data schemas (e.g. XML, JSON data formats) to communicate to and among manufacturing devices and more intuitive programming languages replace restrictive G-code, we will usher in an era of U.S. prowess in manufacturing and technology.

AMT realized there are some areas of the RFI that the association is more uniquely positioned to answer. Given that and the opportunity to directly engage active AMT members in the machine tool and control system market, AMT compiled input for this response from three separate meetings: AMT Board of Directors (3/2/16), AMT Technology Issues Committee (3/8/16), and an AMT-hosted RFI workshop (3/10/16 – 3/11/16). Based on the Board and TIC feedback along with clarifying questions posed to invited government representatives, AMT focused the capstone workshop on four questions: 1) what is the business case for an MII?; 2) what is the

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1 See Appendix for list of members and participants
technology / technical case for an MII?; 3) what is the sustainability case for an MII?; and 4) what is the cost-share case for an MII?
Key Industrial Input

The Business Case: Machine Tools and Control Systems Significantly Move the U.S. Economic Needle

MANUFACTURING R&D IS VITAL TO U.S. COMPETITIVENESS

Manufacturing is a top wealth-generating industry, and its value to our economy and national security cannot be understated. The machine tools and controls market is a roughly $8.39 billion\(^2\) market within the manufacturing technology sector, impacting a $1.99 trillion U.S. manufacturing industry value add.

Currently, the United States is at a competitive disadvantage with other countries when it comes to creating the technologies behind machine tools and control systems, which are among the most advanced pieces of equipment utilized in manufacturing. As machines reach ever-higher levels of technical sophistication, and the factory moves to the digital enterprise, the cycle and

\(^2\) US Production $5,245 million + Net Import $3,151 million; source: Source: Census Foreign Trade Data & Annual Survey of Manufacturers 2014, and AMT
speed of innovation is moving at its most rapid pace ever. However, the United States risks going without adequate resources for R&D for designing, prototyping, and developing these technologies, putting us in peril of falling behind.

Investment in R&D is absolutely critical to our industry’s health. However, because of its inherent risk relative to ROI, firms are reluctant to spend without a level of certainty on return. This reduces the number of types of advancements available to the industry. This is not unlike any other industry’s supply-demand function, but due to the multitude of industrial requirements along with a restrictive supply of development resources this creates a very costly innovation scenario for individual firms in the machine tool and control system sector. A Manufacturing Innovation Institute (MII) dedicated to machine tools and controls could serve to amortize that cost across multiple companies from multiple industries. Such an MII would reduce risk to those businesses while also serving the good of the entire manufacturing industry by developing and advancing technologies required by the advent of the digital factory, in addition to a rapidly growing industry demand for new materials and processes.

The Technology Case: Innovation within Machine Tools and Control Systems has Potential for Exponential Advancements

AN MII FOR ALL OTHER MII PROCESSES

Due to the significant size of and dependency upon the machine tool and controller markets, there is a tremendous opportunity to greatly impact the overall U.S. manufacturing industry with a few near-term and highly focused areas of such technology development. While there may be other manufacturing technologies hyped (and positioned) for higher near-term gain in discrete technology development, there is a high risk that industry acceptance and adoption may lag at a
cost to global competitiveness. Advancements in machine tools and control systems have a relatively lower-risk path to acceptance and adoption while still better positioning the United States in the global market. *The key is to ensure that the best enablers within machine tools and control systems are focused, prioritized and harmonized given other MII strategies.*

Industry stakeholders have identified these specific areas as those generating the most interest:

- **Improved HMI and server-based controls:** A consistent theme from stakeholder comments was improving not only the interface between the human and the machine, but even more focus on revolutionizing the controller’s programming language. If an MII could focus the U.S. talent around reducing the barriers to programming, controls, and the use of a machine tool, then there is a high potential for the United States to move ahead of its global competition.

- **Cost-effective, integrated automation:** Embedded sensors are moving toward ubiquity in a number of industrial applications. In machine tools, they are also necessary for improving human-machine interface. However, integration and automation costs remain a barrier. Development of technologies to lower the cost of integration and automation would be of high value to industry. In fact, the closer that industrial robots are focused on workpieces (i.e. the part itself) the more synergistic machine tool and control R&D would also be with robotics. *It seems logical that soft and adaptive robotics may have very similar goals in developing such enabling technologies, but with some areas of development outside at least the near-term goals of machine tools and controls.*

- **Quality-driven manufacturing:** As the aforementioned embedded sensing and processing technologies could reduce the costs and burden of automating industrial applications, there were also many comments about bringing the enabling technologies of
inspection to the “left” in manufacturing. That is to say that the inspection technologies should be leveraged as drivers of a manufacturing process and not a subsequent post-process step. A suggested moon shot for the manufacturing industry (potentially for multiple, relevant MIIs) was to return to an earlier initiative, First Part Correct. This initiative was a motivation for the Smart Machine Initiative, but may have been a bit before its time. Now that the enabling technologies are more readily available the US industry is in its best position ever to leap frog all competition and realize First Part Correct.

- **Open-architecture connectivity**: The manufacturing industry has historically produced the most data compared to any other industry; in fact, it produces twice as much as the second-highest data generator – the government (Figure 1).
Industry stakeholders continue to echo that if advancements would move beyond just individual machine tools and holistically advance the manufacturing process that this would provide the largest opportunity to advance U.S. manufacturing competitiveness. It seems that the most important element to further advance processes is the interface and communication between the devices such as controls and machine tools. The manufacturing industry needs to further embrace open architecture frameworks and common data schemas to best position the United States for global competition; exploiting the ever-increasing amount of available data. This is intentionally separate from open “source” tools and methodologies. There are many software platforms and operating systems touting the ability to crowd-develop with little-to-no rights on individual...
intellectual property (IP). “Architecture” is being used intentionally to instead tout the openness of features like interfaces, data dictionaries and referencing protocols to better enable scale-up.

**ADDITIONALLY…IMPROVED CONTROLS FOR AN IMPROVED LABOR FORCE**

The U.S. manufacturing workforce is aging, with skilled workers retiring from the industry at a pace faster than they are being replaced. Monthly estimates put this skills gap on average around 300,000\(^3\) unfilled positions industry wide (as of January 2016) and expected to be two million by 2025\(^4\), a critical threat to U.S. manufacturing productivity. While there is a renewed interest in apprenticeships, technical education, and other programs that help to build worker skills, the need for ready-to-hire employees continues to grow.

One crucial way that control systems specifically can help to ease this burden is to create a user experience that can improve a machine tool’s ease of use. That includes *gamification and mobile applications that can be applied to control systems, including such technologies as controller and software development kits that exist in the cloud.* While these are familiar

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\(^3\) As reported by Bureau of Labor Statistics; these are monthly unfilled and can be cyclical and seasonal. [http://www.bls.gov/news.release/jolts.nr0.htm](http://www.bls.gov/news.release/jolts.nr0.htm)

\(^4\) [http://www.themanufacturinginstitute.org/~media/827DBC76533942679A15EF7067A704CD.ashx](http://www.themanufacturinginstitute.org/~media/827DBC76533942679A15EF7067A704CD.ashx)
interfaces for many people, and particularly younger people, they also require intensive back-end
development to become viable on the front end.

That means in addition to the need for skilled manufacturing workers on the shop floor,
manufacturing also needs developers, analysts, and architects to further the digital connection
between physical objects and processes. A Manufacturing Innovation Institute having a focus on
control systems could be a catalyst for industry and educational partners to collaborate on
education and training in this technology field.

**The Sustainability Case: Machine Tools and Control Systems have Significant R&D Backlog**

**NEAR, MID AND LONG-TERM DEVELOPMENTS**

Many top U.S. universities are invested in the basic research and development necessary to
further engage at the MII MRL 4 – 7 levels. Institutes such as Georgia Tech, Massachusetts
Institute of Technology, UNC Charlotte and others are prioritizing advancements in machine
tools, precision engineering and control systems, as well as ensuring private firms are either co-
invested or aware of potential paths for industry adoption.

An MII could assist by enabling synergies between the individual paths of university basic
research and private industry applied research toward the more holistic high-risk, high-reward
activities required for the United States to dominate the global competition.

An example of a near, mid and long-term asset regarding the MII’s focus area was also found to
describe a *platform capability* to efficiently, effectively and rapidly test manufacturing readiness
and production maturities. The term “test bed” was often applied to define the environment that
such an MII could create that would allow for beta testing of pre-production ideas, technology and interfaces toward the end of lowering the risk of industrial utilization (MRL 7+). This would be a natural consequence should a machine tool and control system-focused MII also play the role of the “MII for all other MII production processes.”

**The Cost-Share Case: Machine Tools and Control Systems have a High Potential for Shared Investment**

**HELPING MANUFACTURERS OVERCOME RISK**

While overall manufacturing is a top generator of R&D, the machine tool and control system sub-sector has limited resources for the riskier large-scale research that may or may not produce a market-viable product, re-investing about four percent$^5$ of revenue or $332$ million annually back into their companies.

Currently, machine tool revenues are approximately $8.39$ billion of the $23$ billion recognized within the U.S. production of manufacturing technology, four percent revenue yields approximately $332$ million in R&D annually. The $15$ million in private-sector matching funds required for each of the first five years of the MII amounts to about 4.5 percent of that total.

$^5$ Source: Census Bureau, Annual Survey of Manufactures 2014 & 2012 Economic Census and AMT
current annual R&D investment. Obviously, there are stakeholders beyond the machine tool and control systems sub-sector that have an interest in the outcome that would also invest. If the same four percent investment number is applied to total manufacturing technology production, then $920 million or 1.6 percent of current R&D could be tapped to match government funds.

While companies are eager to discover and implement new technologies, many lack the resources for the investment necessary to take on riskier projects with the highest value proposition, likely delaying technical innovations that could have a measurable impact on resolving industry challenges and meeting industry needs. A comment from many AMT members was that while many technical requirements were met through R&D, the development cost was too high to those same customers who posed the requirement. That seems to be where collaboration is key.

A Manufacturing Innovation Institute can be the essential in bringing the collaboration to fruition.
Conclusion

ENSURING U.S. MANUFACTURING’S GLOBAL COMPETITIVENESS

A Manufacturing Innovation Institute focused on machine tools and controls could be an essential component to securing the future of U.S. innovation. Most notably, such an institute can ameliorate companies’ risk in relation to R&D by sharing the cost among a group of industry stakeholders. As control systems fall under the purview of the proposed institute, innovative development of these systems could be instrumental in: 1) improving machine tool capability and performance, and 2) solving our current skilled worker shortage.

Given the current breadth and depth of the machine tool and control system domain and the high-potential inclusion of integrated inspection, robotics and automation, it is more accurately described as “manufacturing technology.” So while machine tools and controls certainly warrant a majority of focus, it would seem feasible to have an MII that is a natural hub for such stalwart processes supporting all other relevant MII work in these areas.

As a member of America Makes and the Digital Manufacturing and Design Innovation Institute, AMT – The Association For Manufacturing Technology supports exploration for the launch of this institute.

For any questions, follow-up or otherwise please contact:

Tim Shinbara, VP – Manufacturing Technology, AMT

Email | Phone: tshinbara@amtonline.org | 703-827-5243
Appendix

<table>
<thead>
<tr>
<th>Company / Institute</th>
<th>Fname</th>
<th>Lname</th>
<th>Title</th>
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<tbody>
<tr>
<td>AMT Board of Directors Members</td>
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</tr>
<tr>
<td>Concept Machine Tool</td>
<td>Jerry</td>
<td>Rex</td>
<td>Executive Vice President</td>
</tr>
<tr>
<td>Hardinge Inc.</td>
<td>Richard</td>
<td>Simons</td>
<td>President &amp; CEO</td>
</tr>
<tr>
<td>Novi Precision Products, Inc.</td>
<td>Ronald</td>
<td>Karais II</td>
<td>President</td>
</tr>
<tr>
<td>Mazak Corporation</td>
<td>Brian</td>
<td>Papke</td>
<td>President</td>
</tr>
<tr>
<td>Etna Products, Incorporated</td>
<td>Christopher</td>
<td>Bailey</td>
<td>President, COO</td>
</tr>
<tr>
<td>OMAX Corporation</td>
<td>John</td>
<td>Cheung</td>
<td>CEO and Co-founder</td>
</tr>
<tr>
<td>DMG Mori USA, Inc.</td>
<td>Thomas</td>
<td>Dillon</td>
<td>Vice Chairman</td>
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<tr>
<td>Felsomat USA, Inc.</td>
<td>Richard</td>
<td>Gilchrist</td>
<td>Chairman</td>
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<tr>
<td>Morris Group, Inc.</td>
<td>Lee</td>
<td>Morris</td>
<td>CEO and Chairman</td>
</tr>
<tr>
<td>DP Technology Corp. - ESPRIT</td>
<td>Paul</td>
<td>Ricard</td>
<td>President</td>
</tr>
<tr>
<td>Allied Machine &amp; Engineering Corp.</td>
<td>Steven</td>
<td>Stockey</td>
<td>Executive Vice President &amp; Owner</td>
</tr>
<tr>
<td>Mid Atlantic Machinery, Inc.</td>
<td>Kevin</td>
<td>Kilgallen</td>
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<td>Flynn</td>
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<td>Scott</td>
<td>Hibbard</td>
<td>Vice President of Technology &amp; Product Management</td>
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<td>Bruce</td>
<td>Oipple</td>
<td>Director North American Sales</td>
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<td>John</td>
<td>Snyder</td>
<td>Senior Mechanical Engineer</td>
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<td>Gilmore</td>
<td>Vice President &amp; Chief Technical Officer</td>
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<td>Vijayaraghavan</td>
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<td>Steve</td>
<td>O'Neal</td>
<td>Engineering Director-Metal Cutting/Composites</td>
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<td>Jason</td>
<td>Walter</td>
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<td>Dormer Pramet</td>
<td>Russell</td>
<td>Reinhart</td>
<td>U.S. National Sales Manager</td>
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<td>MAG Automotive, LP</td>
<td>Doug</td>
<td>Watts</td>
<td>Chief Technical Officer</td>
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<td>Craig</td>
<td>Ronald</td>
<td>Director, New Product Development</td>
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<td>Drake Manufacturing Services Co.</td>
<td>Richard</td>
<td>Sanders</td>
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<td>Dean</td>
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<td>LaMarca</td>
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<td>Shinbana</td>
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<td>Alex</td>
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<td>Scott</td>
<td>Smith</td>
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