

U+ LABS

THE FUTURE TODAY

2016 ANNUAL REPORT

THE FUTURE TODAY: A LETTER FROM OUR CHAIRMAN AND OUR CEO

At UI LABS, we are constantly looking beyond the status quo to determine what's next—the tool that will change the way manufacturers manage their supply chains, the technology that will halve the time that streets are torn up for construction, and even the new business models that unlock the value of data.

Advances related to internet-connected devices, big data, and supercomputing will benefit first movers and early adopters. The positive effects will ripple outward from the cities, regions, and countries that lead the way.

In 2016, our network of leaders in manufacturing and infrastructure began to see outcomes as the first rounds of UI LABS projects finished. These projects are bringing unlikely partners together to validate new technologies and solve major digital industrial challenges.

We are demonstrating how augmented reality can be used to translate work instructions, making it easier for manufacturing workers to learn new tasks. Our water infrastructure project is collecting data to measure the effectiveness of different methods of flood prevention. Our partners are creating new software tools to reduce the complexity of designing with advanced composite materials, and to eliminate waste and time in setting up new machining processes.

These examples are just the start. Dozens of projects closing over the coming year will show where digital technology can take us, pulling the future forward by drawing on the resources of the brightest minds and most determined innovators across industry, academia, startups, and government. We are also enhancing our Innovation Center to enable real-world learning and experimentation on an active production line, developing new city partnerships to extend the impact of our projects, and creating new alliances among the world's leading industrial and tech companies and cutting-edge startups.

This is collaboration in action. This is a new model for impact. This is the future today.



Warren E. Holtsberg
Chairman



Caralynn Nowinski Collens
Chief Executive Officer

A TRUSTED GUIDE TO INNOVATION

At a time when rapidly evolving market conditions make it imperative to reinvent our approach to R&D, UI LABS is a trusted guide to innovation for courageous leaders with a mandate to redefine the future of their industries.

We design collaborative experiences, leveraging collective talent and resources, to validate new technologies and business models and solve industrial challenges. Together, our partners demonstrate transformative solutions that have industry-wide impact—today and for generations to come.

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POSITION THE FUTURE OF R+D

For decades, the percentage of R&D funding from the federal government has been decreasing, many corporate R&D centers have diminished in size and scope, and our nation's innovation engine—universities and startups—has struggled to connect with both public and private sources of investment in many parts of the U.S.

Our country needs a new partnership model that brings all of these players together, directs resources to the right problems, and catalyzes breakthrough solutions. Without new products, processes, and businesses emerging on a steady basis, our economy will stagnate.

UI LABS is applying this model to manufacturing and infrastructure, with 300+ partners at the table. We invite courageous leaders to join us.

POSITION THE FUTURE OF MANUFACTURING

The United States has fallen far from its place as a global manufacturing leader in the 20th century. Scores of manufacturing jobs have disappeared—more than five million since 2000. Almost no complex products are entirely made in the United States.

Still, manufacturing matters, employing nearly 10 percent of the nation's workforce and accounting for 12 percent of its GDP. We have a legacy on which to build a new foundation and the ingenuity to reimagine manufacturing for the 21st century.

Advanced technologies and a high-skilled workforce will be key differentiators that make U.S. manufacturing the most competitive in the world, enhancing productivity, rebalancing trade in our favor, creating high-wage jobs, and generating trillions of dollars in economic wealth.

The Digital Manufacturing and Design Innovation Institute (DMDII), an innovation platform of UI LABS, has focused its efforts on areas with the greatest potential to reinvent manufacturing in the United States:

- Design, product development, and systems engineering
- The “Factory of the Future”
- Agile, resilient supply chain
- Cybersecurity for manufacturing

The global trend toward Industry 4.0 will bring about the next manufacturing revolution, whether the U.S. is involved or not. But, we have the capacity to lead this revolution, unlocking new economic value and creating new jobs. Read more about DMDII and learn how to get involved on our website¹.

¹<http://www.uilabs.org/innovation-platforms/manufacturing/>

POSITION THE FUTURE OF INFRASTRUCTURE + CITIES

America's infrastructure is crumbling. Tragedies like bridge collapses and dam failures have underscored the human impact of chronic underinvestment.

Rebuilding roads, rail, and waterways is imperative to improve resiliency and economic competitiveness. But it's not sufficient in and of itself—modern infrastructure is as much digital technology as it is concrete. Any large-scale effort to overhaul the nation's infrastructure must include the integration of smart technologies.

Our water and sanitation systems need sensors and electronic controls to monitor and redirect flow. Our bridges and roads need more efficient maintenance that can be better managed with advanced data collection and analysis. Our trains and cargo need to move faster and more safely.

Rethinking the way we have invested in infrastructure as a nation is no small task, but we stand to benefit from increased safety and reliability, economic development, security, and quality of life. Read more about City Digital, UI LABS' platform on smart infrastructure in cities and communities, on our website² and in Crain's Chicago Business³.

²<http://www.uilabs.org/innovation-platforms/cities-infrastructure/>

³<http://www.chicagobusiness.com/article/20170214/OPINION/170219961/bigly-isnt-enough-infrastructure-must-be-built-smartly-too>

POSITION THE FUTURE OF WORK

As automation and internet-connected machines become more widespread, many fear that “lights out” factories—remotely controlled to the extent that they don’t require comforts like heating and lighting—will become the norm.

The reality is that achieving productivity gains that will allow the U.S. to compete globally will be less about replacing workers and more about augmenting their capabilities through technology and training.

When increased output and efficiency of domestic manufacturing make an appealing enough business case, we could see the reshoring of entire supply chains.

Additionally, digital manufacturing and smart infrastructure have something very important in common: they require skilled workers on an ongoing basis. Hardware and software technicians and data scientists will be critical to the future of work.

UI LABS is facilitating and providing the foundations required for effective manufacturing workforce development, leveraging a network of partners and stakeholders across industry, academia, government, and non-profit organizations. Access our online “Digital Manufacturing 101” course here⁴, and follow our portfolio of workforce development activities on our website⁵.

⁴<https://www.coursera.org/specializations/digital-manufacturing-design-technology>

⁵<http://www.uilabs.org/innovation-platforms/manufacturing/workforce-development/>

UI LABS IN ACTION: DEMONSTRATING TRANSFORMATIVE SOLUTIONS

UI LABS provides our partners with access to new approaches, technologies, testbeds, and relationships, guiding them toward solutions that will drive innovation in their industries. Learn more about the unique role that UI LABS plays on our website⁶, and read on about a selection of our projects in the following pages.



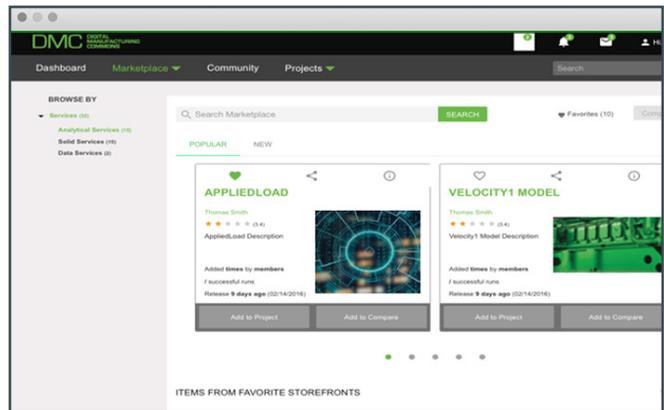
Underground
Infrastructure Mapping



Smart Green
Infrastructure Monitoring



Green Dynamics:
New Design for a New Era



Digital Manufacturing
Commons

⁶<http://www.uilabs.org/what-is-ui-labs/how-we-work/>

UNDERGROUND INFRASTRUCTURE MAPPING

In September 2016, City Digital introduced the underlying technology components to create a new underground infrastructure mapping (UIM) platform. The platform generates, organizes, visualizes, and stores 3D underground infrastructure data, saving cities and utilities millions of dollars in construction and planning processes.

Using the City of Chicago as a testbed for the platform's development, the pilot team is deploying the new technology to create an accurate 3D map of underground assets—water pipes, fiber optic lines, gas pipes, electrical lines, and legacy infrastructure—located in city streets and alleys. An engineering-grade, cloud-based data platform enables this critical infrastructure information to be securely stored and shared among the City of Chicago and utilities.

The UIM pilot's technology and processes were developed by a broad consortium of government, industry, and academic partners at City Digital. In addition to the City of Chicago, the team includes Accenture, ComEd, Microsoft, HBK Engineering, Cityzenith, Esri, and the University of Illinois at Urbana-Champaign.



By improving the accuracy of underground infrastructure information, the platform will prevent inefficient and delayed construction projects, accidents, and interruptions of services to citizens.

CITY OF CHICAGO CIO BRENNAN BERMAN



As a result of inaccurate or obsolete data on below-ground assets, an underground utility line is hit on average every 60 seconds in the United States, according to the American Public Works Association.



State governments have estimated the potential to unlock \$21 in value for every \$1 invested in underground asset management by reducing accidents, damages, and delays.

SMART GREEN INFRASTRUCTURE MONITORING

Flooding is local, but its causes are system-wide. Through targeted deployment of green infrastructure across the larger system, cities can help address the flooding happening now and remain resilient in the face of future changes to climate and weather patterns—while at the same time beautifying public spaces.

City Digital has deployed a new solution that combines sensors and cloud-based analytics to evaluate the performance of sustainable stormwater management techniques. Using data collected from green infrastructure sites in Chicago, the platform helps to reduce urban flooding and prevent millions of dollars in property damage.

City Digital and its partners have installed sensors at three green infrastructure sites in Chicago to collect water runoff data. The ability to securely collect, publish, and interpret quantifiable data, the technology enables a performance-based management approach and better informed capital planning for infrastructure investments, such as the \$50 million the City of Chicago has allocated for green stormwater management.

In the coming months, the team plans to install sensors at two new Chicago locations, analyze historical and live-streamed data, and provide site-specific design recommendations. The performance data will be made public through the City of Chicago's open data portal in 2017.

The partners in this project include three City of Chicago departments—Department of Innovation and Technology, Department of Transportation and Department of Water Management—along with Microsoft, Opti, Senformatics, and AECOM. Additional thought leadership and pilot support were provided by West Monroe Partners and Glasswater Technology.



Innovative approaches like this system will empower engineers, researchers, and policy-makers to dissect the water and environmental issues facing cities and assess and implement creative solutions

**ANNEMARIE LEVINS, GENERAL MANAGER FOR TECHNOLOGY &
CIVIC ENGAGEMENT, MICROSOFT**



Flooding in the Chicagoland area due to excess stormwater over a five-year period resulted in more than 181,000 claims of property damage with a total estimated cost of \$773 million, according to the Center for Neighborhood Technology.



The Federal Emergency Management Agency (FEMA) estimates that total flood insurance claims average more than \$1.9 billion per year nationally.

GREEN DYNAMICS: NEW DESIGN FOR A NEW ERA

In Fall 2016, Green Dynamics, a California-based technology company, completed work on a project to create a new Blade Multi-Disciplinary Design and Analysis (“Blade MDA”) software. This integrated tool suite streamlines composite design for wind turbine manufacturers, helping them more easily analyze a complex turbine or blade system.

Growth in the use of composite materials, which are used in the wind energy industry as well as others including the automotive industry, has been limited by a number of factors—from high materials costs to labor-intensive manufacturing methods to lack of experienced designers—despite their potential for weight reduction and performance enhancement. Industry has developed tools for composite design, but they are not integrated and require different file formats, user interfaces, and a high level of designer expertise.

The Blade MDA software created by Green Dynamics, now in alpha release, builds upon technology developed by the Department of Defense to simplify the design process and reduce the wide range of expertise typically required to analyze wind energy components. The tools included in the software can improve the competitiveness of small wind turbine blade manufacturers and potentially open new markets for composite materials.

The University of Delaware, Vanderbilt University, MetaMorph Inc., PTC, Penn State Applied Research Laboratory, and MSC Software contributed to the technology development alongside Green Dynamics.



Our software eliminates the need for expertise in a diverse set of technical program user interfaces, instead overlaying one simple graphical interface. The user never directly builds the multiple domain analysis models; they give input about the overall geometry within a simple user interface, and that builds the model for them.

NEIL GUPTA, CO-FOUNDER, GREEN DYNAMICS



Flooding in the Chicagoland area due to excess stormwater over a five-year period resulted in more than 181,000 claims of property damage with a total estimated cost of \$773 million, according to the Center for Neighborhood Technology.



According to the National Highway Traffic Safety Administration and the Environmental Protection Agency, a 10% reduction in vehicle mass typically results in a 6.5% decrease in fuel consumption.

DIGITAL MANUFACTURING COMMONS

The Digital Manufacturing Commons (DMC) is an open-source software platform that links people, data, and tools that enable organizations to share solutions across the manufacturing product life cycle.

It's a challenge to manage the information generated at multiple touch points between OEMs and suppliers, and it's time-consuming to translate proprietary file formats created along the way. The DMC addresses these issues by providing secure workspaces to share and annotate project files across the supply chain and offering options to view or translate CAD files directly on the platform.

The DMC also provides small manufacturers with access to low-cost, easy-to-use manufacturing simulations and apps that streamline their design and manufacturing processes. Many smaller manufacturers are unable to use digital manufacturing tools given their high price points and knowledge requirements.

The DMC had its alpha launch in November 2016 and its beta launch in January 2017. These releases allowed partners to log in to the portal; test out new features, such as a DMDII members-only area and an app marketplace; and provide feedback. UI LABS also held a hackathon in July 2016, where teams of students, coders, entrepreneurs, and makers used data from DMDII partner ITAMCO to glean insights about the manufacturer's operations, and created apps to be housed on the DMC.

The DMC's full commercial launch will take place in mid-2017.



There can be over 18,000 different components and parts that go into the jet engines we produce today. We may source as much as 80 percent of these parts with external manufacturing supply chain partners. Suppliers have a wide range of 'digital savvy' capabilities, and very few have the same IT or software systems. This makes interoperability a significant challenge. Digital collaboration, through the use of Model Based Enterprise in an appropriately open, collaborative, and secure environment like the DMC, provides a huge promise toward improving supply chain integration and overall agility.

JOHN MATLIK, CHIEF OF MANUFACTURE AND SERVICE SYSTEMS, ROLLS-ROYCE CORPORATION



Sectors Represented by DMC Users:

- Government/Other: 31%
- Academic: 22%
- Industry: 47%



12 projects actively being integrated into the DMC, representing over \$16 million in investment

THE COMPANY WE KEEP: PARTNERSHIPS WITH IMPACT

Throughout 2016, the UI LABS network has broadened to include organizations that bring new industries and capabilities to the table. A few examples:

Faurecia

Joined: March 2016

Organization type: Tier 1 automotive parts manufacturer

Revenue: 15.6 billion EUR (2016)

Headquarters location: Nanterre, France

Number of employees: About 98,700

Interested in:

Digitalization to increase operator performance, connect and integrate supply chain, and control quality of production.

Johnson & Johnson

Joined: August 2016

Organization type: Medical device, pharmaceutical, and consumer health and beauty care company

Revenue: 71.89 billion USD (2016)

Headquarters location: New Brunswick, NJ

Number of employees: About 127,000

Interested in:

Using cutting-edge advances in digital technology to improve the sourcing, manufacturing, and delivery of our products to our customers.

McKinsey & Company

Joined: August 2016

Organization type: Management consulting firm

Revenue: Not disclosed

Founded in: Chicago, IL

Number of employees: About 22,000

Interested in:

Shaping winning strategies, mobilizing for change, building capabilities, and driving successful execution.

Northrop Grumman

Joined: September 2016

Organization type: Aerospace and defense technology company

Revenue: 23.53 billion USD (2015)

Headquarters location: Falls Church, VA

Number of employees: About 65,000

Interested in:

Collaborating with industry and academia to accelerate the transition to digital manufacturing across the enterprise. Our continuing goal is to provide superb products to our customers around the world that offer an overwhelming advantage when it matters most.

Stanley Black & Decker

Joined: December 2016

Organization type: Tools and storage, commercial electronic security, and engineered fastening systems

Revenue: 11.4 billion USD (2016)

Headquarters location: New Britain, CT

Number of employees: About 55,000

Interested in:

Building out the “factory of the future” at the UI LABS Innovation Center to show how digital technologies can transform manufacturing.

Clemson University

Joined: November 2016

Organization type: University

Location: Clemson, SC

Enrollment: About 17,000 undergraduate and 4,600 graduate students

Interested in:

The human element of manufacturing and the integration of humans to the digital enterprise, among other collaborative research interests.

Illinois Manufacturing Excellence Center

Joined: May 2016

Organization type: Non-profit committed to driving growth through enterprise excellence and guiding organizations as they plan, implement, and excel in all areas of Leadership, Strategy, Customer Engagement, Operations, Technology and Workforce. IMEC is part of the U.S. Commerce NIST-MEP network.

Headquarters location: Peoria, IL

Number of employees: About 50

Interested in:

Assisting Illinois small and mid-sized manufacturing firms to adopt digital technologies to make their operations run more efficiently and improve profitability.

Rescale

Joined: December 2016

Organization type: SaaS Simulation and cloud HPC company

Funding raised: \$20.4M, with participation from Microsoft Ventures, Jeff Bezos, Peter Thiel, Richard Branson

Headquarters location: San Francisco, CA

Number of employees: 51

Interested in:

Building the “product of the future” by taking a realistic simulation and artificial intelligence driven approach to the design process.

Opti

Joined: June 2016

Organization type: IoT/SaaS provider of Continuous Monitoring and Adaptive Control (CMAC) technology

Headquarters location: Boston, MA

Number of employees: 22

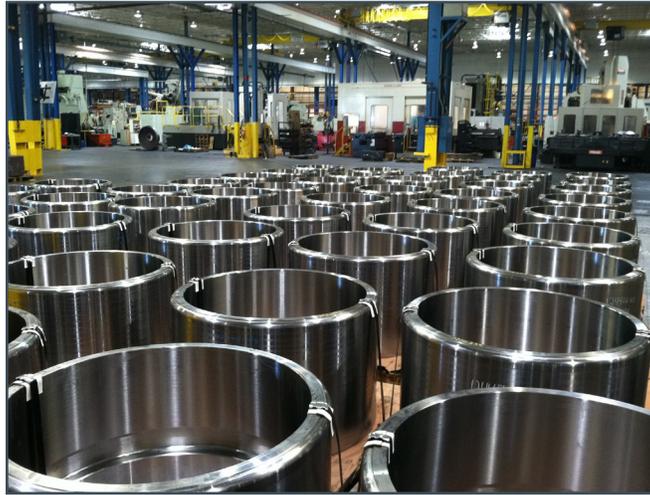
Interested in:

Delivering reduced flood risk and improved water quality at the watershed scale for communities around the country.

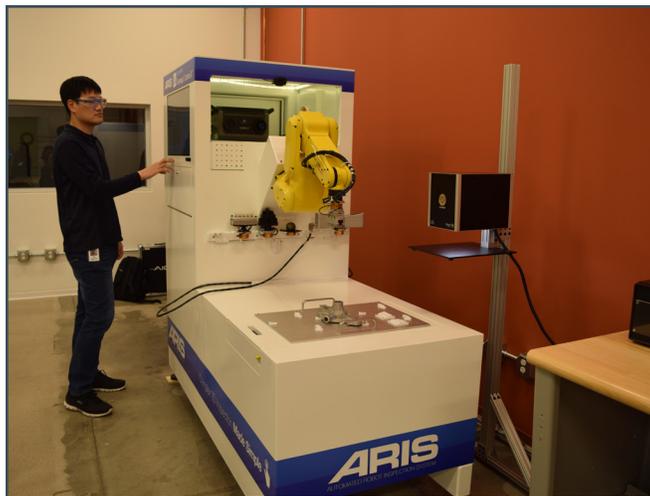
See a full list of UI LABS partners at uilabs.org/partners

NEW TYPES OF COLLABORATIONS

UI LABS' partners are discovering ways to collaborate outside of the project process, with exciting results.



ITAMCO:
Using DMDII to “hack” the
company’s data



ARIS and Covisus:
A partnership
between startups

ITAMCO: USING DMDII TO “HACK” THE COMPANY’S DATA

ITAMCO, an Indiana-based manufacturer of precision-machined components, has used the DMDII network and resources to its advantage in creative ways. This third-generation American company has grown from a 4,000 square foot machine shop when it was founded in 1955 to nearly half a million square feet of space between two facilities, containing several hundred machine tools.

Over the past several years, ITAMCO has actively monitored its operations by using an open-source, royalty-free manufacturing communications protocol called MTConnect. Gathering information in real time has allowed the company to make adjustments to avoid problems rather than solving them after machines malfunction.

ITAMCO’s leadership knew there were deeper insights to be found within their data and looked to DMDII to help discover them. ITAMCO provided several years’ worth of manufacturing data from its facilities to form the basis of the inaugural Digital Manufacturing Commons (DMC) hackathon, and about a dozen teams explored it, unearthing findings in areas such as energy usage and machine health that ITAMCO was able to use to optimize its functions.



In order to develop new ideas and remain competitive, we need to break out of our silos, and that’s exactly what we’re able to do by working with DMDII. The DMDII network connects us with people we wouldn’t have been able to access otherwise—from large OEMs to entrepreneurs and hackers.

JOEL NEIDIG, DEVELOPMENT AND TECHNOLOGY MANAGER, ITAMCO



According to GE and Accenture, predictive maintenance can reduce overall maintenance costs by 30% and eliminate up to 70% of breakdowns.



Automation and flexible production techniques could improve manufacturers’ productivity by as much as 30%, according to Accenture.

ARIS AND COVISUS: A PARTNERSHIP BETWEEN STARTUPS

Two DMDII member startups, ARIS Technology and Covisus Inc., are working together on a shop-floor system that helps manufacturers automate quality control and process improvement using tag-less tracing and robotic 3D scanning. The companies met through DMDII's first startup showcase in September 2016, and now have technology demonstrations co-located within the UI LABS Innovation Center.

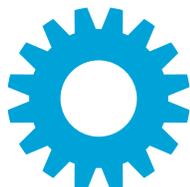
ARIS system utilizes a robotic arm to 3D scan parts on a tray or conveyor belt, bringing high-precision measurement from the lab to the production floor. ARIS software not only compares 3D scan data to CAD design for pass/fail, but also provides real-time feedback from analyzing trends across multiple parts being produced. In performing such automated 3D scanning process, Covisus' virtual tagging system provides part identification without a need for paper tags or barcodes. Covisus' system captures and saves a part's surface texture, which is as unique as a human fingerprint. When the part arrives at ARIS's scanning zone, Covisus' tracking data is linked to ARIS's database to inform the part's identity, i.e., the production number, batch number, etc.

While both companies' technology can be used within a variety of industries, the initial focus of the joint project is the aerospace market. The Covisus system is currently used by Boeing for mitigating counterfeits in the supply chain, and ARIS's system is being implemented at a Tier 1 Aerospace component manufacturer.



The analytics that are generated provide insight into not only the quality data of that specific part, but over time and across production. It's not only about cost savings; these technologies working together can potentially improve revenue by enhancing product quality and competitiveness.

MINGU KANG, CHIEF EXECUTIVE OFFICER, ARIS



A Senate Armed Services Committee report found 1,800 cases of suspected counterfeiting in government procurement, involving close to 1 million parts.



In 2016, UI LABS hosted 16 startups across two events at the UI LABS Innovation Center to showcase their technologies to large companies and their peers.

OUR TEAM



Caralynn Nowinski Collens
Chief Executive Officer



Thomas McDermott
Chief Program Officer
Executive Director, DMDII



Steve Fifita
Executive Officer, City Digital



Paul Seeman
Chief Business Officer

See the full list of our team members on our website⁷.

⁷<http://www.uilabs.org/people/our-team/>

BOARD OF DIRECTORS

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Pedro E. Suarez

President of Dow USA

Mark Tebbe

Chairman of ChicagoNEXT, and Adjunct
Professor and Entrepreneur-in-Residence
at the University of Chicago Booth School
of Business

Mike S. Zafirovski

Executive Advisor to Blackstone and
member of the Board of Directors of three
Blackstone portfolio companies

2016 HIGHLIGHTS: BY THE NUMBERS

FINANCIALS:

UI LABS REVENUE FROM OPERATIONS

(IN \$MILLIONS)



STATS:



60+

PROJECTS UNDERWAY



300+

PARTNERS ACROSS
34 STATES



130+

PARTNERS JOINED IN 2016 -
NEARLY 85 OF WHICH ARE
SMALL AND MEDIUM-SIZED
BUSINESSES

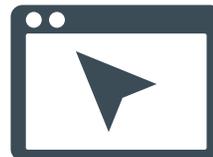


\$6,000,000

IN EQUIPMENT AND SOFTWARE ON THE MANUFACTURING FLOOR

20

NEW JOB PROFILES RELATED
TO DIGITAL MANUFACTURING
PROFIED AS PART OF OUR
WORKFORCE EFFORTS.



59

TEAM MEMBERS



14



DIRECTORS ON OUR BOARD
REPRESENTING INDUSTRY, ACADEMIA,
AND NON-PROFIT SECTOR



DMDII IS ONE OF 14
INSTITUTES IN THE
MANUFACTURING USA
NETWORK



5 CITY DIGITAL PILOT
SITES ACROSS
THE CITY OF CHICAGO



300+

USERS OF THE DIGITAL MANUFACTURING COMMONS - REPRESENTING
40+ ORGANIZATIONS - WITHIN THE FIRST THREE MONTHS OF LAUNCH

Digital Enterprise

Siemens Digital

U+ LABS

THE FUTURE TODAY

