APRIL 12 - 15, 2025 ATLANTA, GEORGIA

CASTEXPO

& METALCASTING CONGRESS

connecting SUPPLIERS | METALCASTERS | CASTING BUYERS

Building Resiliency in the Casting Industry

Using Composite, Industry-wide 4.0 Assessment Lessons Learned and Best Practices

APRIL 12 - 15, 2025 ATLANTA, GEORGIA

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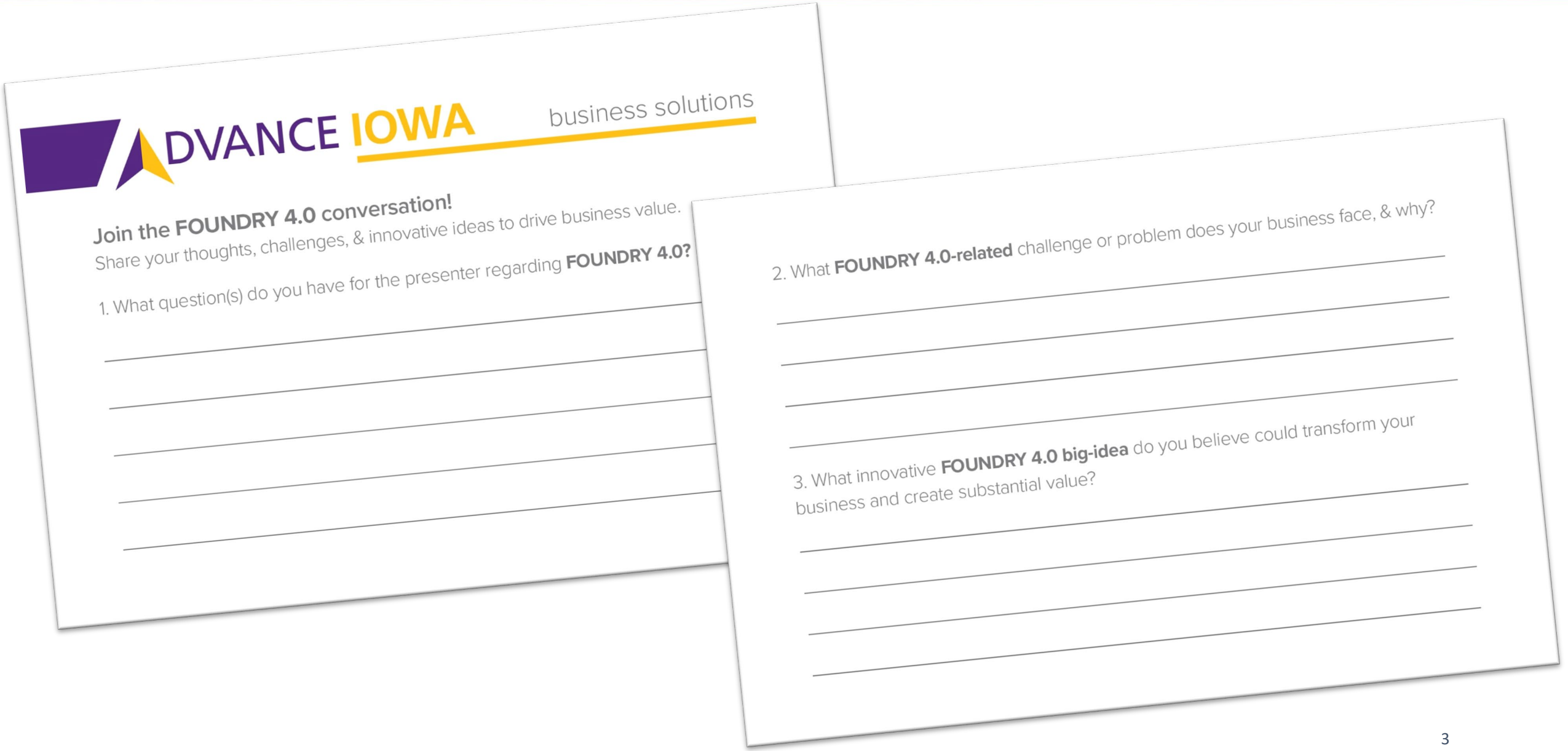
CREATING VALUE THROUGH CHANGE

Please share your questions, challenges and big-ideas



WHY WORRY ABOUT

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FOUNDRY & CASTING INDUSTRY RESILIENCY?

"We're just fine the way we are"

"Industry contraction is normal over time"

"We've been doing this successfully for many years"

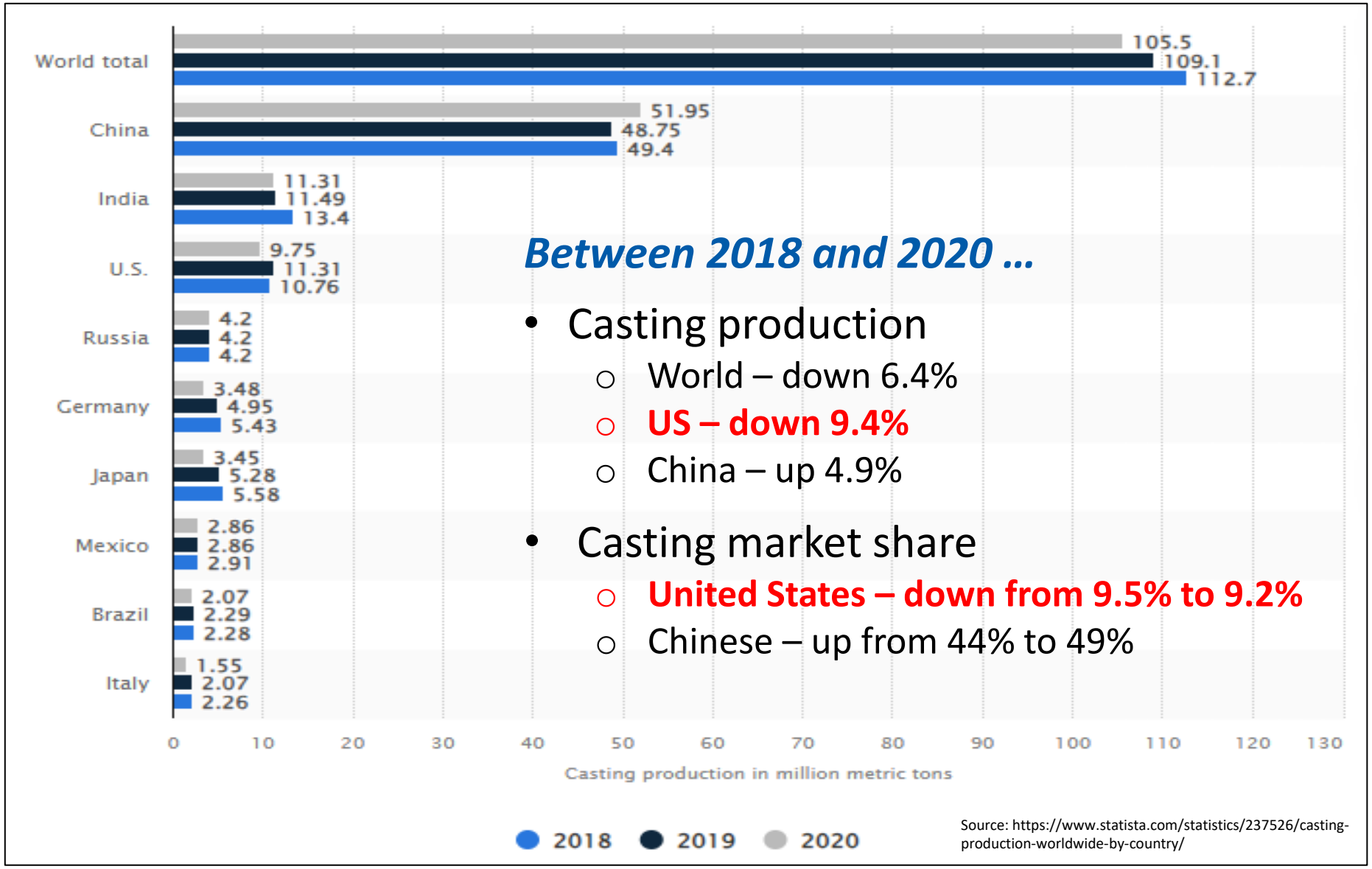
"Our industry is different"

"Without a cost:benefit case for change, change isn't valuable in our business"

"If it ain't broke, don't fix it"

REALLY?

Volume of global casting production



Between 2018 and 2020 …

- Casting production
  - World – down 6.4%
  - **US – down 9.4%**
  - China – up 4.9%
- Casting market share
  - **United States – down from 9.5% to 9.2%**
  - Chinese – up from 44% to 49%

Source: https://www.statista.com/statistics/237526/casting-production-worldwide-by-country/

METALCASTING INDUSTRY STATISTICS

- **US ECONOMIC BENEFIT** from metal casting in 2020[1]
  - **Economic Impact** = $110.5B (Direct = $44.3B)
  - **Jobs** = 492.6K (Direct = 162.8K)
  - **Wages** = $32.2B (Direct = $11.6B)
  - **Tax revenue** = $10.6B
- **US GOVERNMENT** equipment, product and service supply chains **rely** **HEAVILY** on the foundry & casting industry

From 2014 and 2023-est [2]

- 162 (9%) of **existing US foundry facilities closed**
- **Per facility revenue increased** by $6.5M (30%)

1. https://www.afsinc.org/us-metalcasting-industry-impact-us-jobs-economy
2. https://www.foundry-planet.com/d/metalcasting-congress-2023-surpasses-200-exhibitors-more-than-20-first-timers/

Metal Casting MATTERS

Metalcasting Matters for
United States of America

Metalcasting Industry Vital to the U.S. Economy

A highly modern industry with ancient roots and today's cutting-edge technology, metalcasting is the backbone of the manufacturing economy. It is an industry with a total economic output of $110.52 billion that provides almost 500,000 U.S. jobs, directly and indirectly. The industry is central to a growing economy, modern infrastructure, and national defense. Moreover, metalcasting provides excellent careers for those with the right skills.

Metalcasting Matters

U.S. made metal castings are critical to:

- Aircraft
- Appliances
- Automobiles, Motorcycles and Trucks
- Cookware
- Defense Technology
- Farm Equipment Needed to Harvest Food
- Golf Clubs
- Medical Devices
- Mining and Construction Equipment
- Pipes that Deliver Clean Water
- Power Plants that Supply Electricity
- Pulp and Paper
- Railroads and Mass Transit
- Ships and Submarines
- Stadium Seating
- Ventilators
- Wind Turbines

Economy

- More than 1,759 metalcasting facilities nationwide.
- Providing direct & indirect employment for more than 460,000 workers.
- Nearly 80% of U.S. metalcasters are small businesses employing fewer than 100 employees.

This 2020 economic research was conducted by John Dunham & Associates.

Total National Economic Benefit
Direct & Indirect

Economic Impact
$110.52B

Jobs
492,565

Wages
$32.16B

Tax Revenue
$10.59B

Direct Economic Benefit

Industry Jobs
162,816

Wages
$11.61B

Economic Impact
$44.29B

Number of Facilities (Excluding Art Foundries and Educational Foundries)

	2014	2015	2016	2017	2018	2019	2020	2021	2022 est	2023 fcst
Facilities	1,871	1,866	1,787	1,780	1,772	1,765	1,731	1,725	1,715	1,709
Annual Growth		-0.2%	-4.2%	-0.4%	-0.4%	-0.4%	-1.9%	-0.4%	-0.6%	-0.3%

Revenue Per Facility ($ Thousands)

	2014	2015	2016	2017	2018	2019	2020	2021	2022 est	2023 fcst
($ Thousands)	21,743	20,837	19,942	21,256	23,337	25,093	21,205	24,527	27,006	28,258
Annual Growth		-4.2%	-4.3%	6.6%	9.8%	7.5%	-15.5%	15.7%	10.1%	4.6%

Foundry & Casting Industries are IMPORTANT to the United States …

- **… Economy**
  - These industries are valued at approximately **$50 billion**
  - They directly and indirectly support nearly **800,000 jobs** across the supply chain
- **… Manufacturing backbone**
  - **90%** of all manufactured goods contain some metal castings
  - You are rarely more than **10 feet away** from a metal casting in the United States
- **… Industrial innovation and workforce skills development**
  - Metalcastings **are a part of** every car and truck, every railway car and engine, every building and every piece of heavy equipment used for construction and agriculture
  - Metalcasting supports a payroll of more than **$8 billion**, and metalcasters in the US are **predominately small businesses**, with about **75% of domestic metalcasters having fewer than 100 employees**

Sources:
- https://www.afsinc.org/about-metalcasting
- https://www.afsinc.org/industry-statistics
- https://www.afsinc.org/importance-metalcasting-0

HOW CAN WE IMPROVE RESILIENCY?

AFS CASTEXPO & METALCASTING CONGRESS

Effective ways to IMPROVE FOUNDRY RESILIENCY

Technology & Innovation

- **Adopt Advanced Technologies**: Implement AI, automation, and IoT.
- **Focus on Innovation and R&D**: Prioritize research and development for new methods and materials.

Operational Efficiency

- **Implement Lean Manufacturing Practices**: Minimize waste and optimize processes.
- **Regular Maintenance and Upgrades**: Keep equipment well-maintained and up-to-date.

Supplier & Supply Chain Management

- **Strengthen Supplier Relationships**: Foster collaboration with suppliers.
- **Diversify Supply Chains**: Reduce dependency on a single source.

Workforce & Training

- **Invest in Workforce Training**: Continuous training and development for employees.

Communication & Collaboration

- **Enhance Communication Channels**: Establish clear and regular communication between stakeholders.

INDUSTRY 4.0: & HOW DID WE GET HERE?

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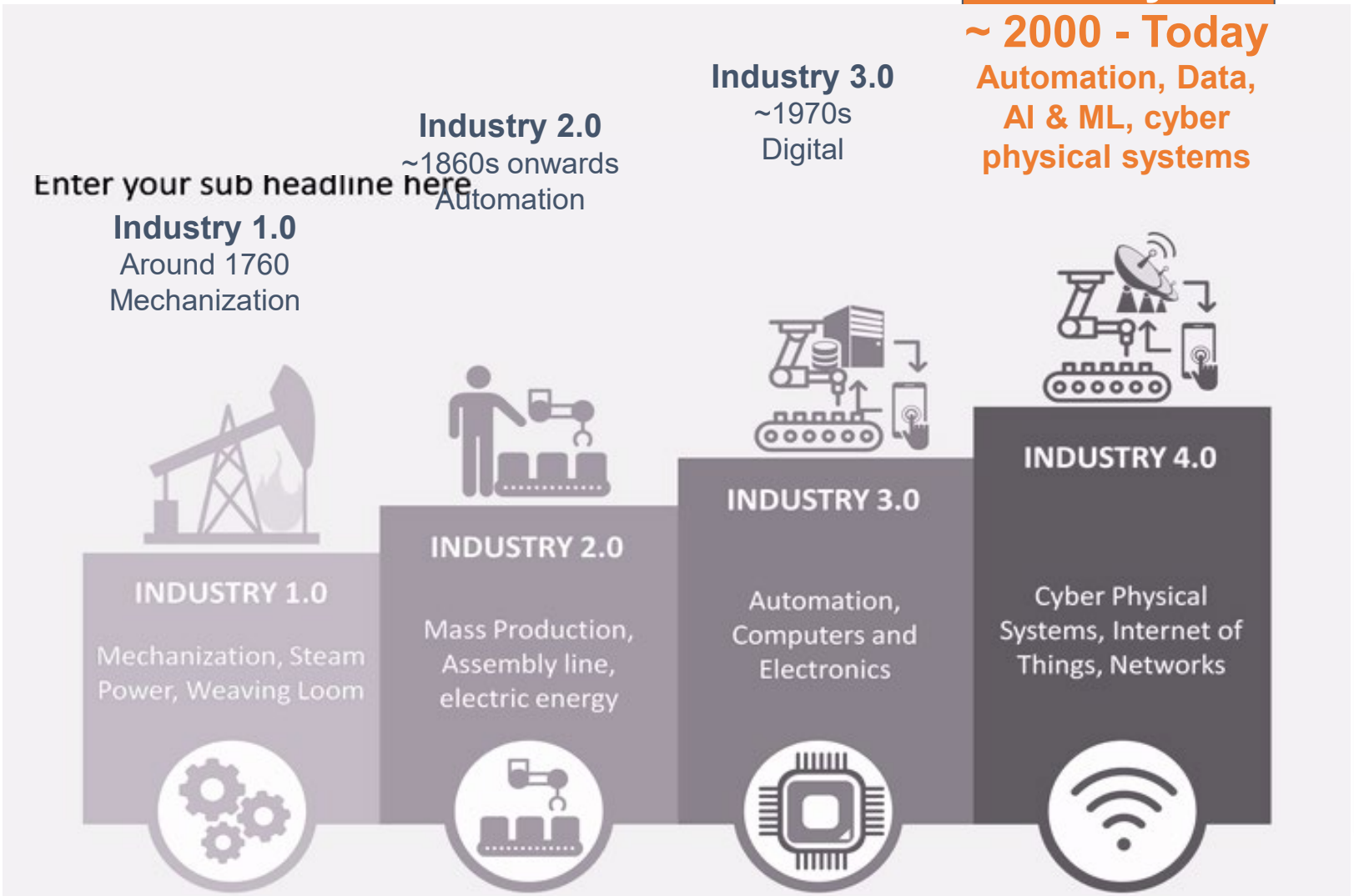
Industry 4.0
~ 2000 - Today
Automation, Data, AI & ML, cyber physical systems

Industry 3.0
~1970s
Digital

Industry 2.0
~1860s onwards
Automation

Enter your sub headline here

Industry 1.0
Around 1760
Mechanization



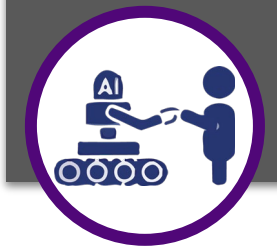
NOTE:
INDUSTRY 4.0 applied to an industry can become *"Foundry 4.0", "Manufacturing 4.0", "Logistics 4.0"* … all apply similar principles

AUGMENTING OUR WORK FORCE

Industry 5.0
Concept was presented by Japan at the CeBIT 2017 trade fair in Hannover (Society 5.0)

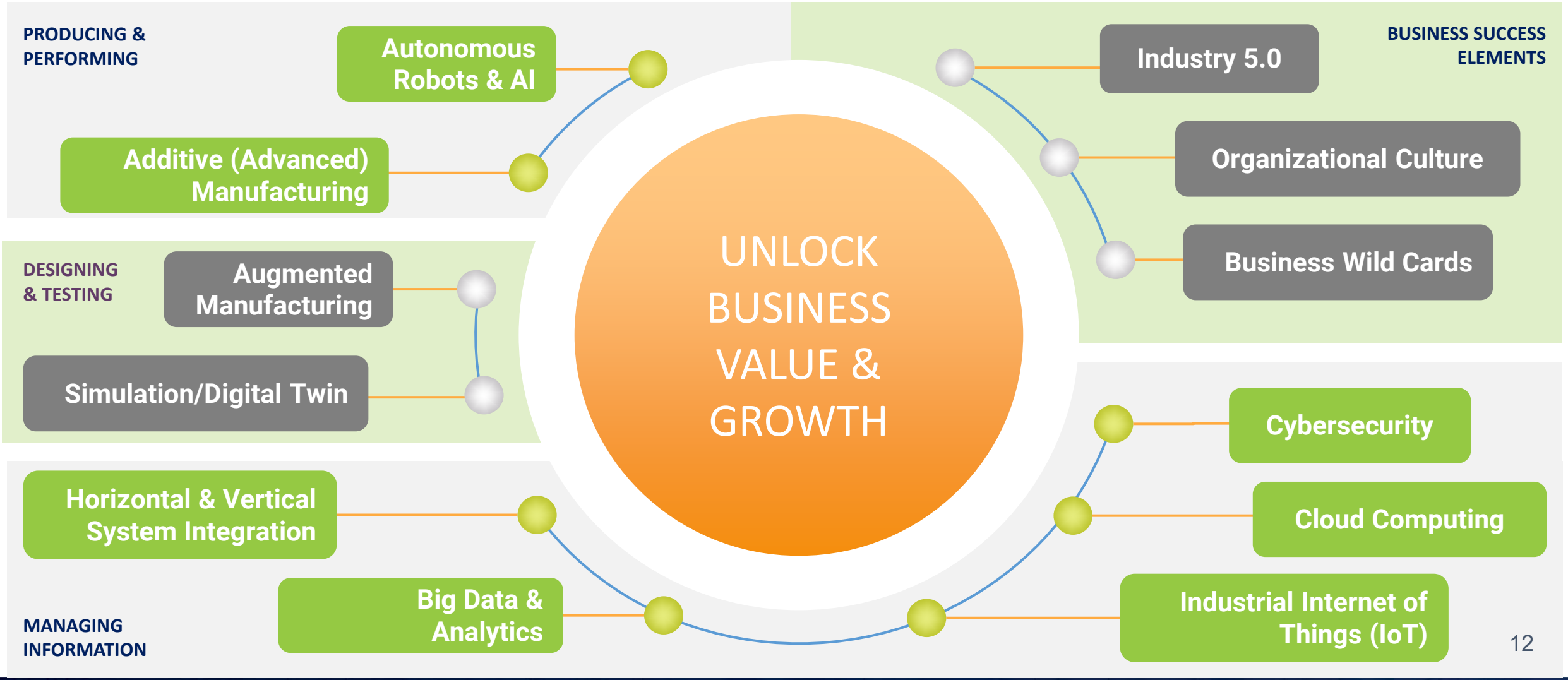
INDUSTRY 5.0

Is future of work, referring to people utilizing robots and intelligent machines to drive productivity and economic growth



Reference: industry-4-slide2.png, available at: https://www.sketchbubble.com/en/presentation-industry4.html (Accessed: October 2023).

F4.0 READINESS TECHNOLOGY PILLARS



Periodic Table of **Industry 4.0 Elements**

Understanding the essential aspects necessary to thrive during this transformative time

Internet of Things **IoT** 1															Real-Time Capability **RTC** 2
Artificial Intelligence **AI** 3	Cloud Computing **CC** 4									Adv. Planning & Scheduling **APS** 5	AI Anomaly Detection **QC** 6	IoT-Based Usage Reports **IoTR** 7	SOTA/FOTA Updates **OTA** 8	Digital Services **DS** 9	Information Transparency **IT** 10
Cybersecurity **C** 11	Digital Twins **DT** 12	Edge Computing **EC** 13	Increased Productivity **IP** 14	Improved Quality **IQ** 15	New Market Penetration **NM** 16	Data-Driven Decisions **DD** 17	Adv. Process Control **APC** 18	Adv. Process Automation **PA** 19	Condition Monitoring **CM** 20	IoT-Based Worker Safety **IoTS** 21	Remote Asset Monitoring **RAM** 22	Location Tracking **LT** 23	Subscription Models **SM** 24	Interoperability **I** 25
Big Data Analytics **BDA** 26	Advanced Robotics **RO** 27	Autonomous Vehicles **AGV** 28	Low Code / No Code **LCNC** 29	Operational Agility **OA** 30	Revenue Growth **RG** 31	Personalized Experiences **PE** 32	Advanced Analytics **AA** 33	AI-driven Forecasting **AIF** 34	Network Optimization **NO** 35	Knowledge Management **KM** 36	Remote Service & Support **RSS** 37	Device Management **DM** 38	Servitization **XaaS** 39	Service Orientation **SO** 40
Augmented Reality **AR** 41	3D Printing **AM** 42	Drones **DR** 43	Virtual Reality **VR** 44	Innovation Acceleration **IA** 45	Reduced Costs **RC** 46	Product Customization **PC** 47	Predictive Maintenance **PdM** 48	Digital Modeling **DM** 49	Connected Worker **CW** 50	Adv. Energy Management **AEM** 51	Monitoring Dashboards **MD** 52	Fleet Management **FM** 53	Platform Ecosystems **PE** 54	Modularity **M** 55
Quantum Computing **QC** 56	Blockchain **B** 57	5G **5G** 58	Machine Vision **MV** 59	Sustainability Advancement **SA** 60	Forecast Accuracy **FA** 61	Supply Chain Resiliency **SCR** 62	Remote Operations **RO** 63	Supply Chain Control Tower **SCCT** 64	Factory Control Tower **FCT** 65	Adv. Inventory Management **AIM** 66	Remaining Useful Life **RUL** 67	Energy Monitoring **EMN** 68	Data Monetization **DM** 69	Autonomous Operations **AO** 70

Enabling Technologies

Value Drivers

Operational Use Cases

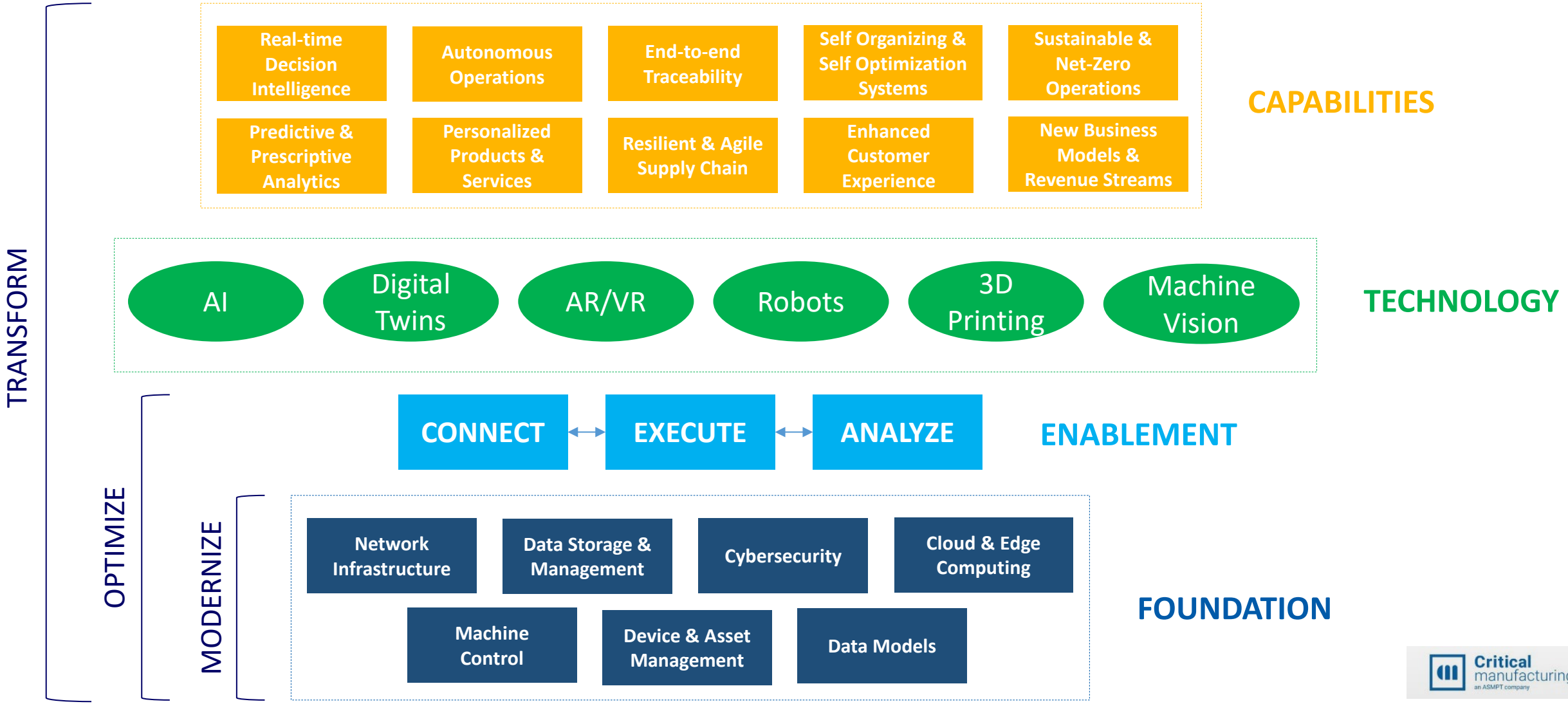
Product Use Cases

New Business Models

Design Principles

Jeff Winter

Making INDUSTRY 4.0 a Reality



Critical manufacturing
an ASMPT company

PROJECT MISSION:

Create **resiliency** in the **FOUNDRY & CASTING INDUSTRY** through the implementation **of INDUSTRY 4.0 TECHNOLOGY**

"This research is sponsored by the DLA-Troop Support, Philadelphia, PA and the Defense Logistics Agency Information Operations, J68, Research & Development, Ft. Belvoir, VA."

Reference: PEXELS Photo cy Kateryna Babaieva, pexels-kateryna-babaieva-2747017.jpg, https://pexels.com

NCDMM

UNI University of Northern Iowa. Business & Community Services

FOUNDRY 4.0

Technologies revolutionizing the metal casting industry!

SHAPING THE FUTURE OF AN INDUSTRY

FOUNDRY4.0@NCDMM.ORG

F4.0 Partnership (DLA) Outreach Results

FOUNDRY 4.0 PARTNERSHIP ENGAGEMENT SUCCESSES IN NUMBERS...

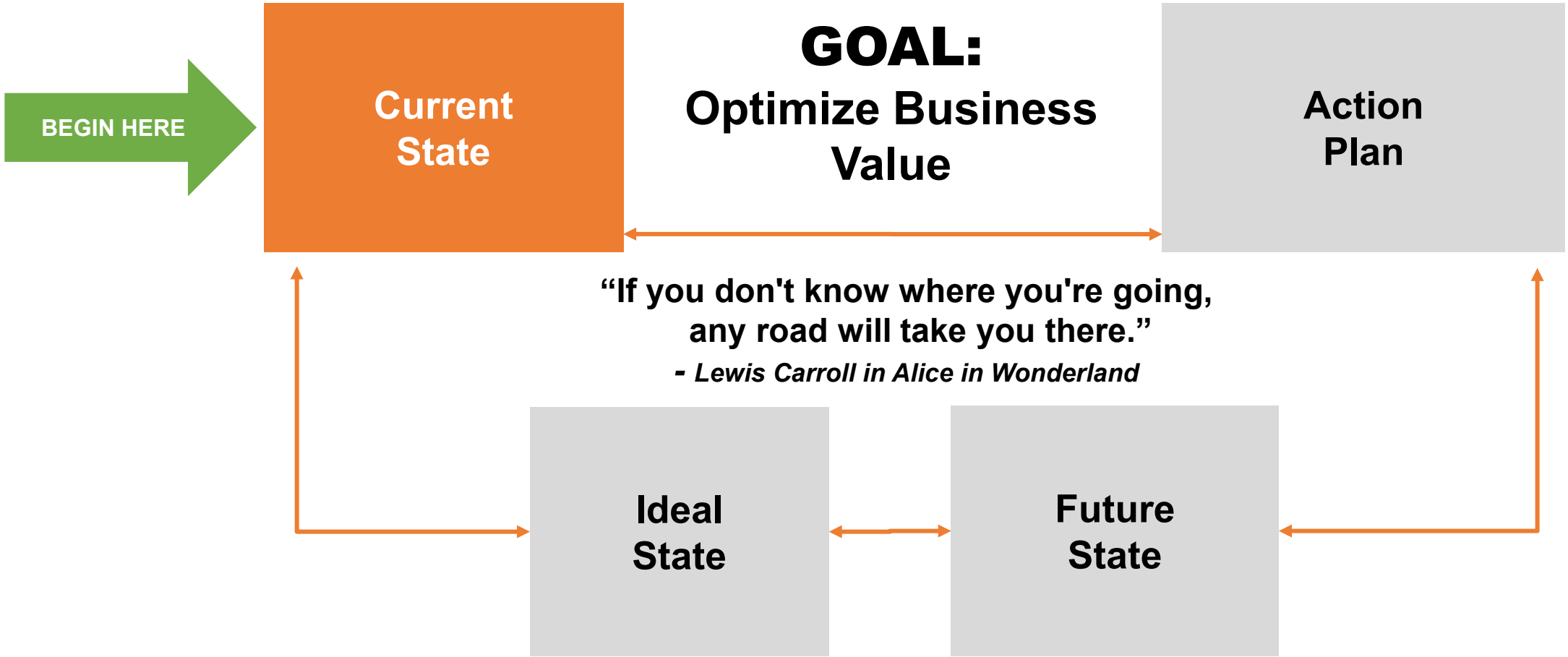
7,401 INDIVIDUALS ACTIVELY PARTICIPATED IN conferences, seminars, workshops, tours & other events!

685 ATTENDEES PARTICIPATED in PRESENTATIONS during our events about F 4.0 TOPICS.

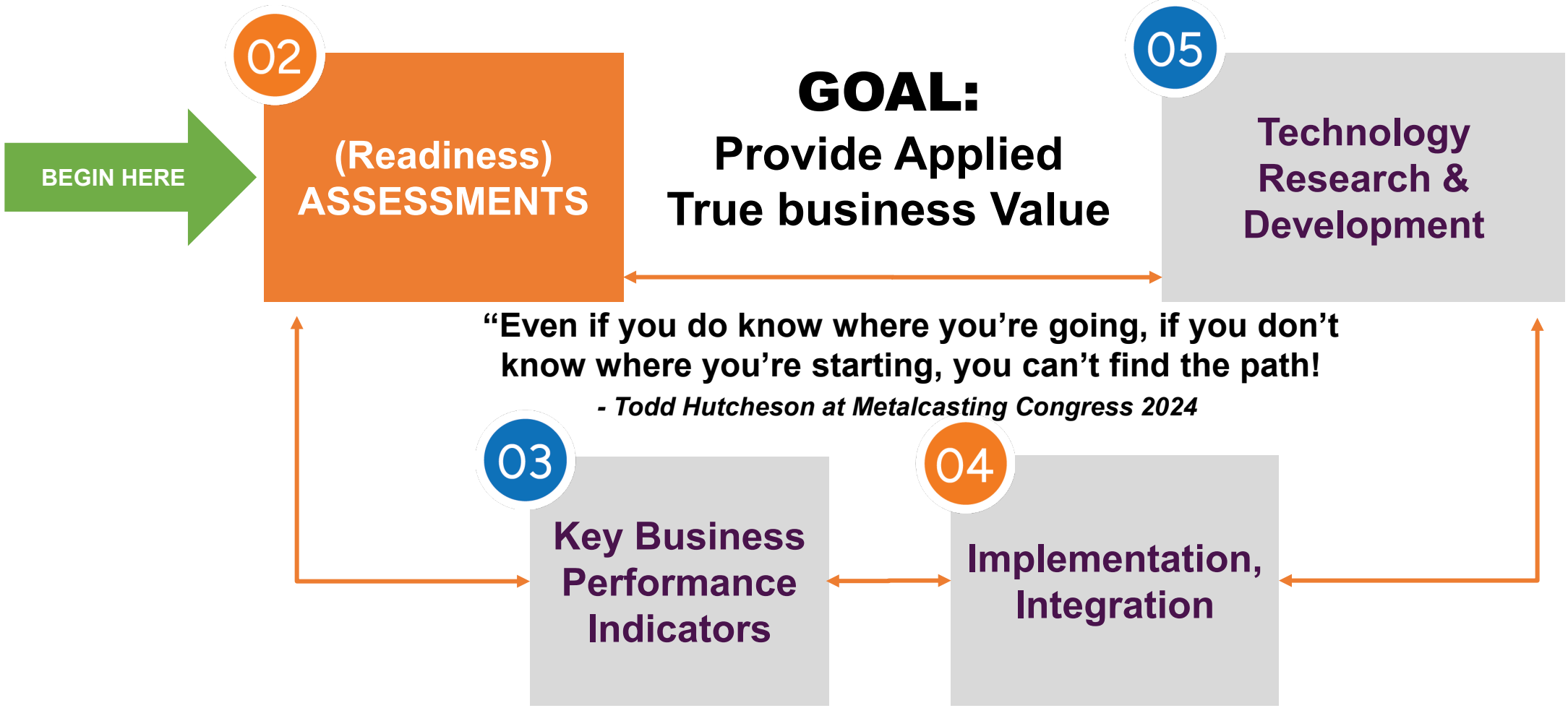
WE HELD A TOTAL OF **421** CONVERSATIONS with experts from **242** COMPANIES!

145 SUBJECT MATTER EXPERT INPUTS gathered from assessments at **19** DOMESTIC U.S. COMPANIES!

I4.0 IMPROVEMENT METHODOLOGY



I4.0 IMPROVEMENT METHODOLOGY



SUMMARY: ELEMENTS OF INDUSTRY 4.0

IMPROVEMENT IMPLEMENTATION

A FACILITATED SELF-ASSESSMENT EMPHASIZING:

1. Ease of use/engagement
2. Collaborative involvement of multiple functions and SME perspectives
3. Assessment result connection to business value

AUTOMATED ASSESSMENT

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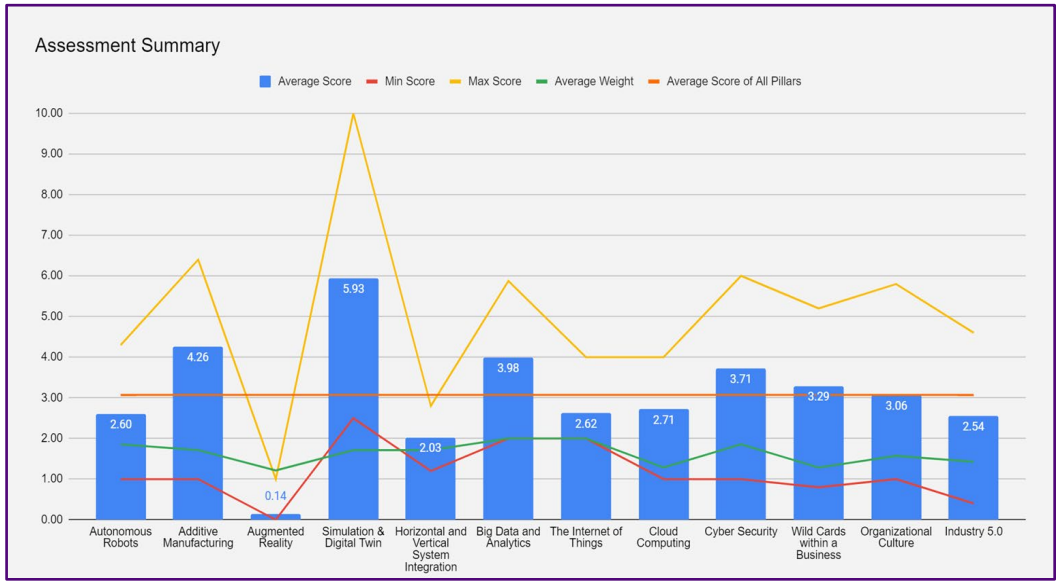
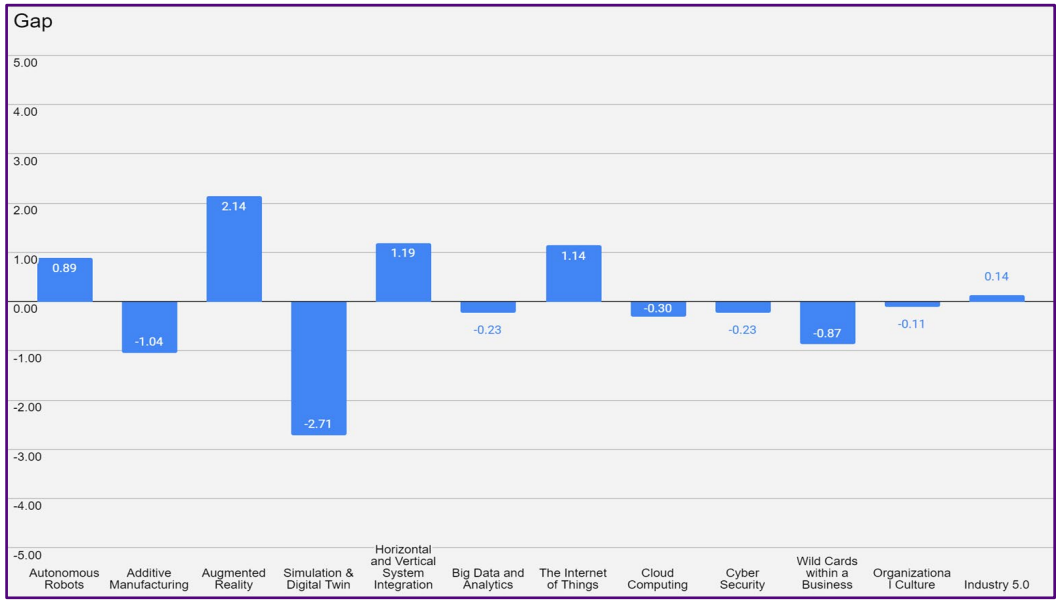
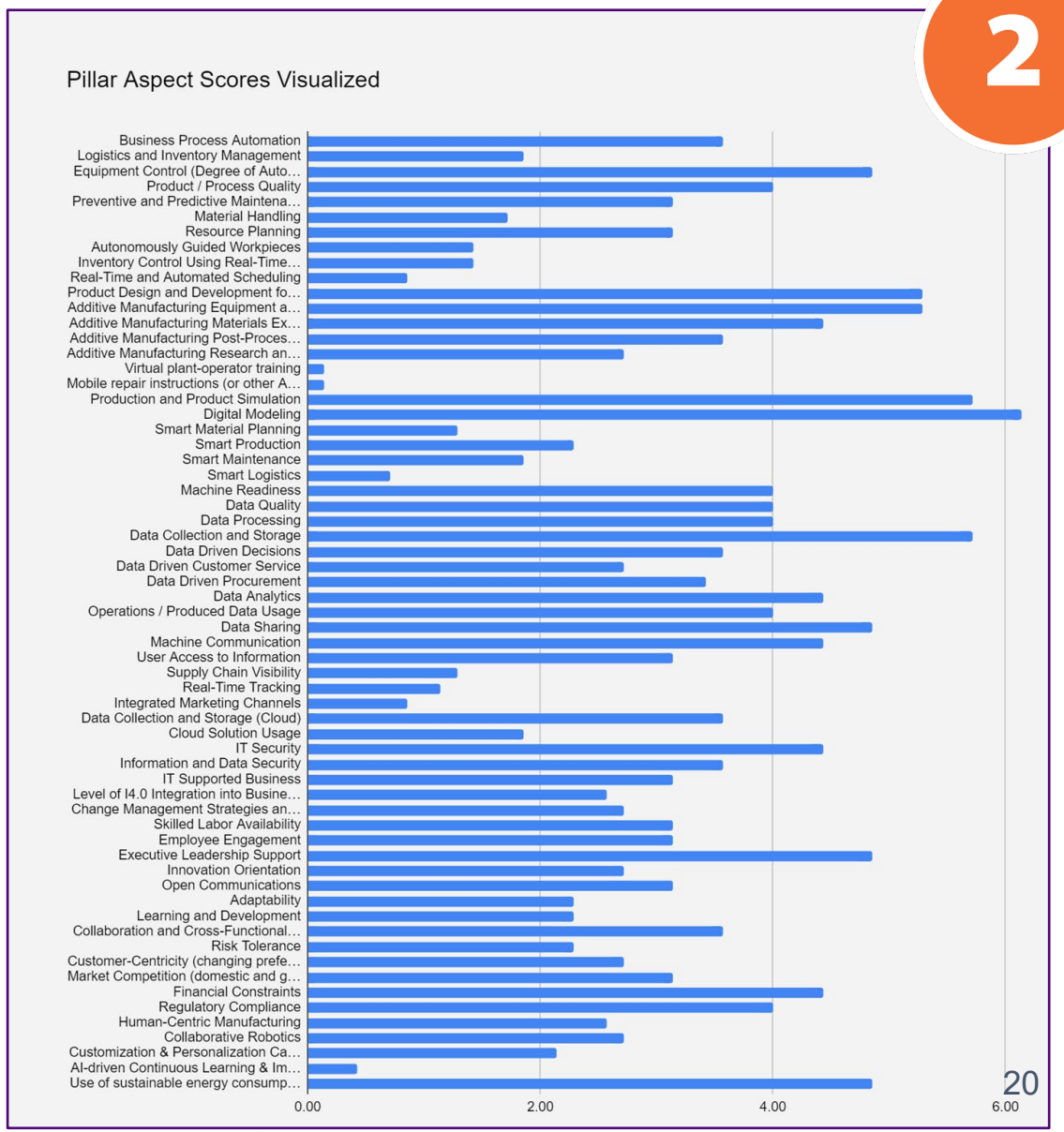
2

EXAMPLE

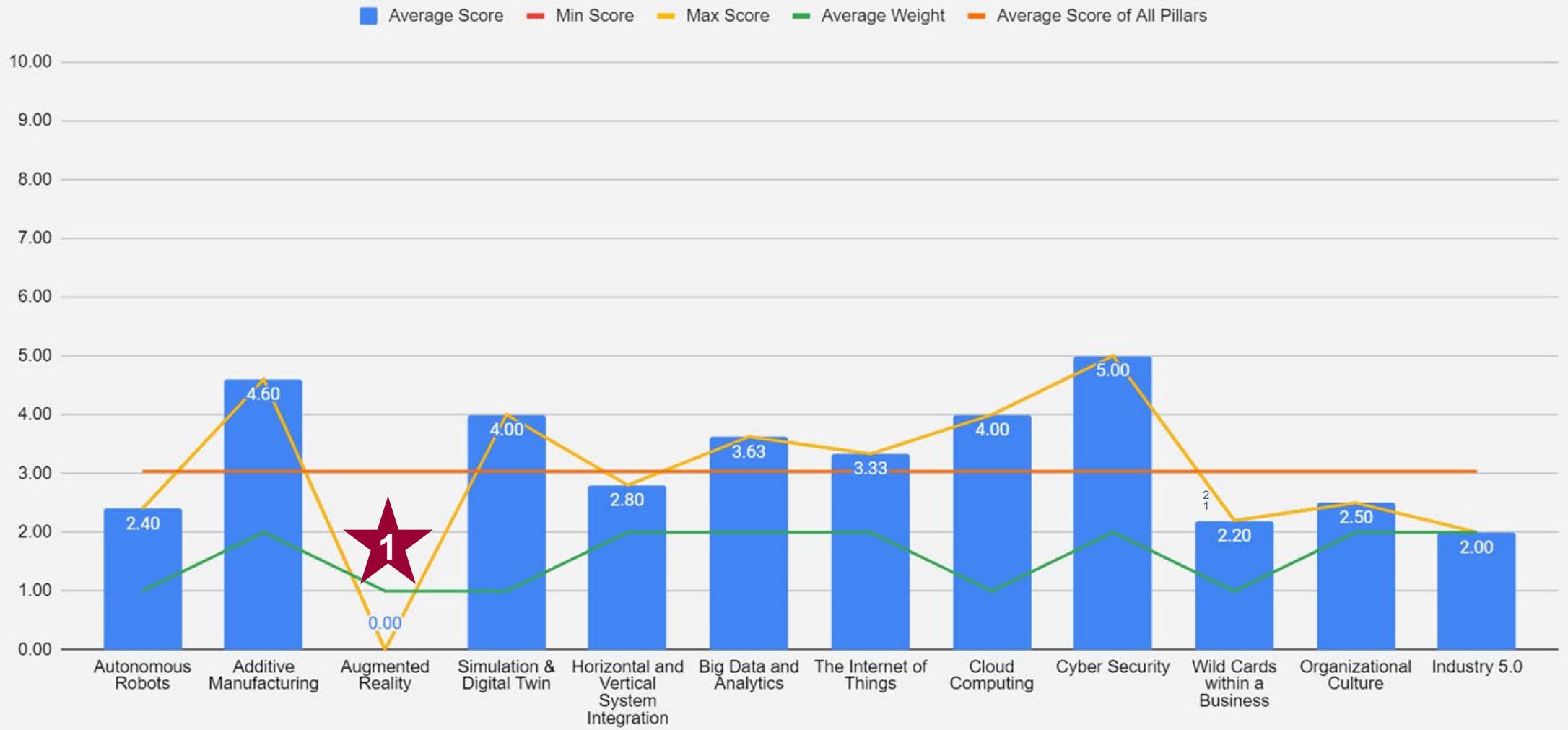






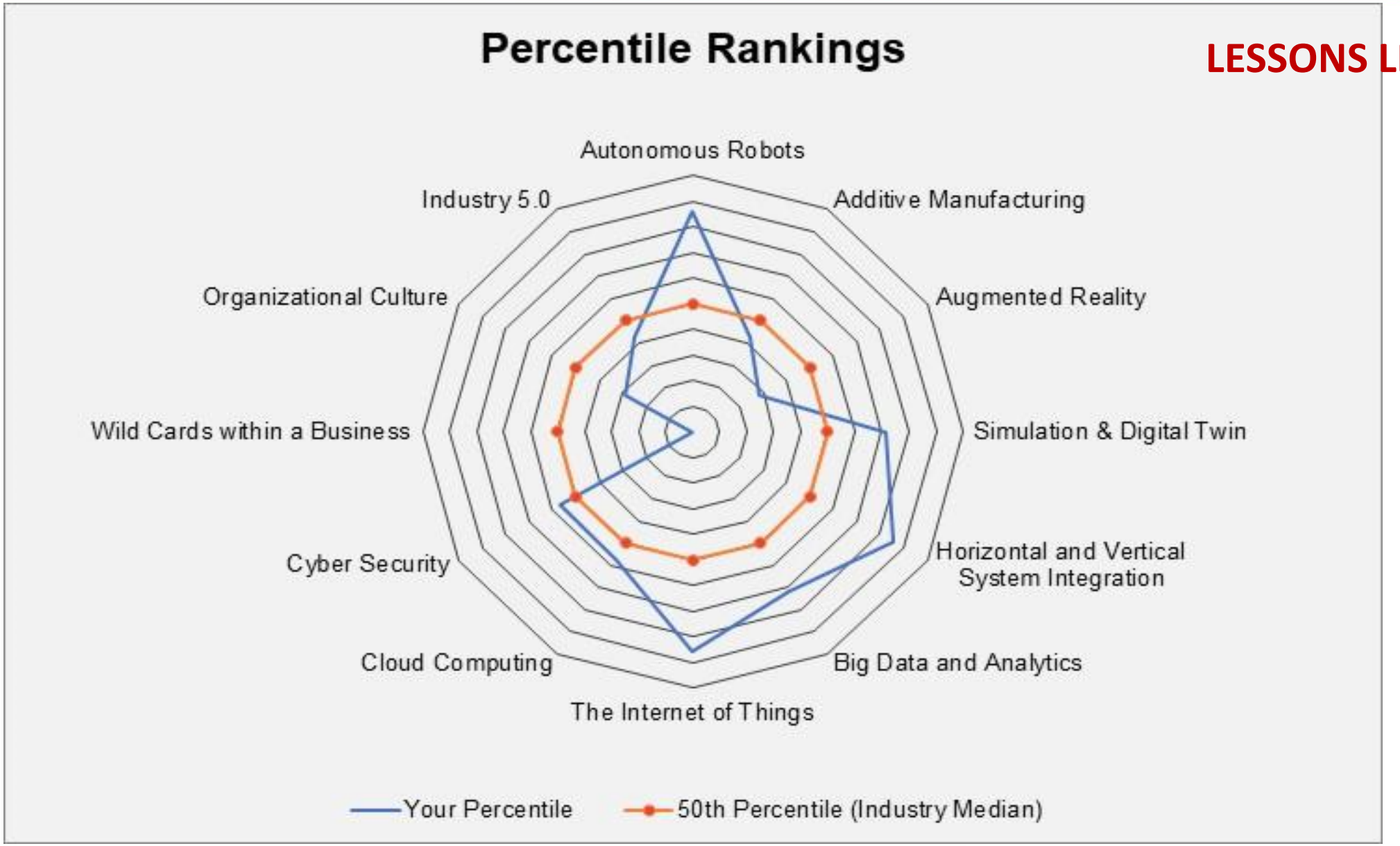
SCORE STATISTICS BY PILLAR

3



We can also provide
Company comparisons to Industry Averages ...

LESSONS LEARNED



F4.0 READINESS ASSESSMENT

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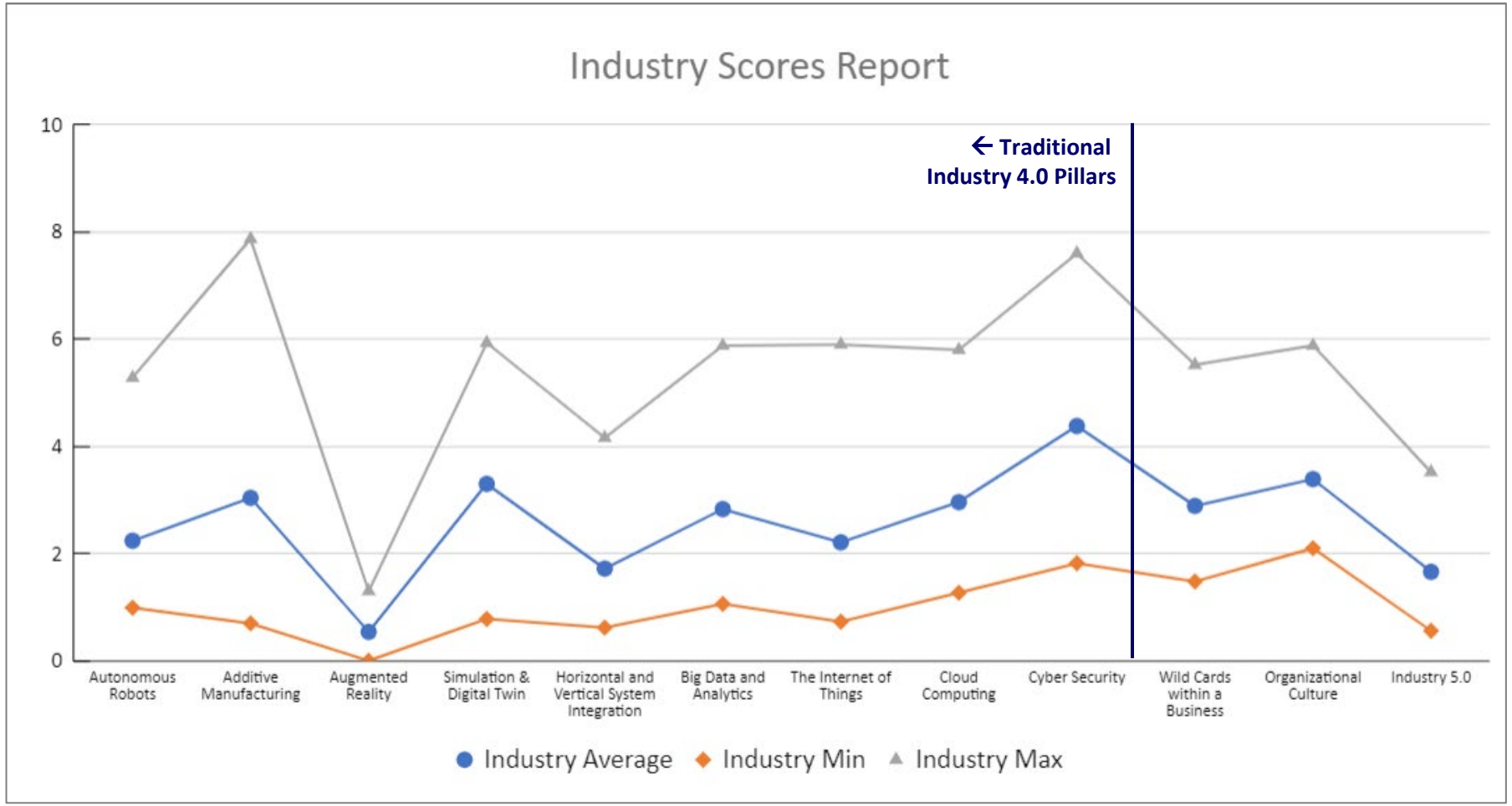
We are building collective
METAL CASTING industry averages …



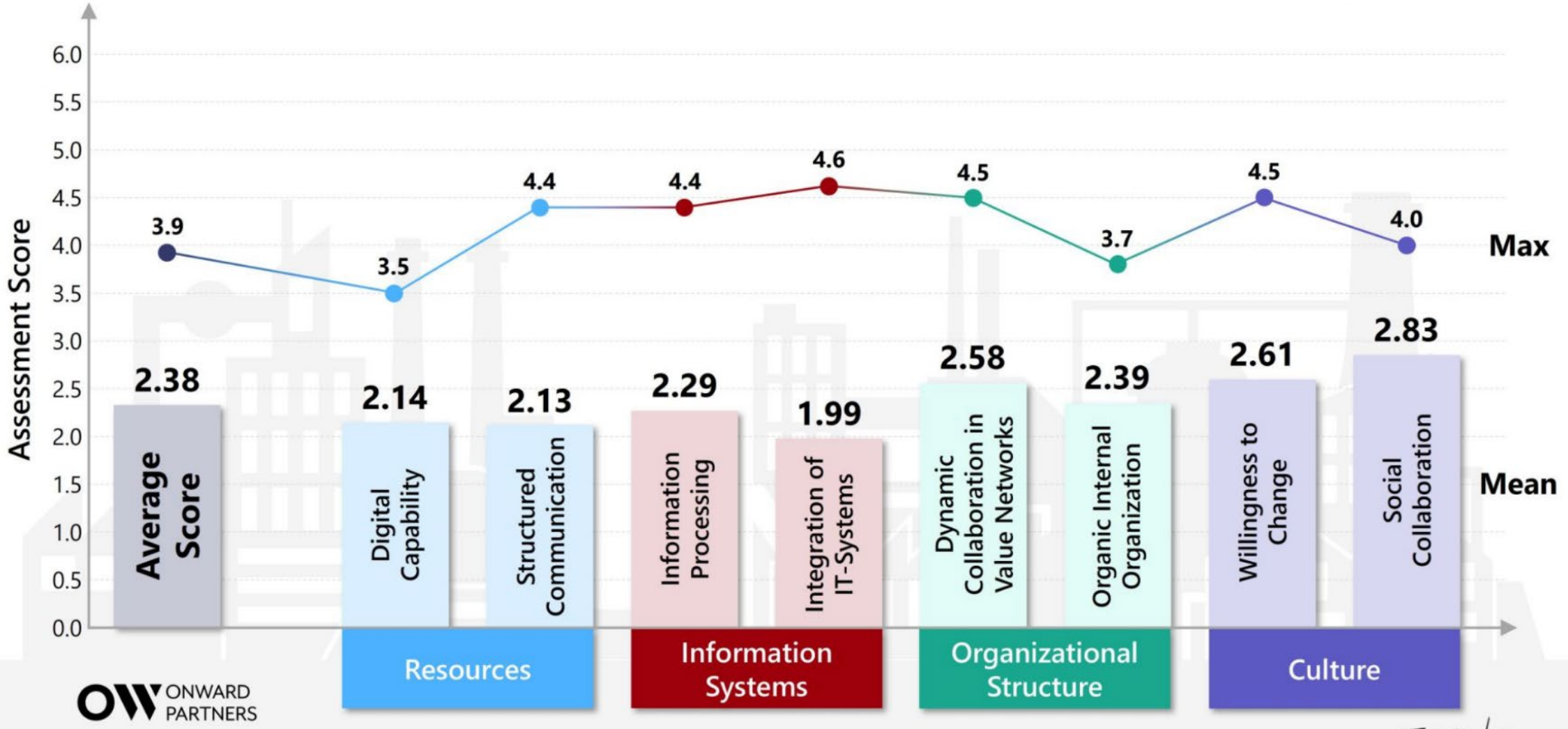
LESSONS LEARNED

Received to date:

- **148 inputs from**
- **19 companies**
- **All US Domestic**

Industry 4.0 **Benchmarking Data**

Based on Acatech's Industrie 4.0 Maturity Index from 387 Assessments Conducted in 40 Countries Between 2019 to July 2024



ONWARD PARTNERS

Source: Onward Partners – Benchmark on Industry 4.0: Discover the Hidden Chal

METAL CASTING industry averages …

LESSONS LEARNED

Lowest scoring traditional I4.0 technology pillars

- Augmented Reality
- Horizontal and Vertical System Integration
- Internet of Things
- Autonomous Robots
- Big Data & Analytics

F4.0 READINESS ASSESSMENT

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LESSONS LEARNED

Lowest scoring questions in the most "active" technology pillars …

Autonomous Robots

- Inventory Control Using Real-Time Data
- Material Handling/Transfer

Additive Manufacturing

- 3D Printing
- Post-Processing and Finishing
- Additive Manufacturing Materials Expertise

Simulation & Digital Twin

- Production and Product Simulation
- Digital Modeling

Big Data and Analytics

- Data Driven Customer Service
- Data Driven Procurement

The Internet of Things (IoT)

- Supply Chain Visibility
- Real-Time Tracking
- Equipment and Environmental Sensors

UNLOCK BUSINESS VALUE & GROWTH

with Foundry 4.0 Readiness Assessment

- ✓ Confidentiality Assured.
- ✓ Efficient & Straightforward.
- ✓ Free Access. (at No Cost)

SCAN THE QR-CODE!

or go to https://bit.ly/3ybbb2O
to complete the registration form.

& KICK-START YOUR FUTURE

UNI University of Northern Iowa. Business & Community Services

Last Tactical Mile Seminar Series

CASTEXPO & METALCASTING CONGRESS

Introducing …

An exciting opportunity for foundry technical personnel, showcasing applied Industry 4.0 technical solutions!

Objectives:

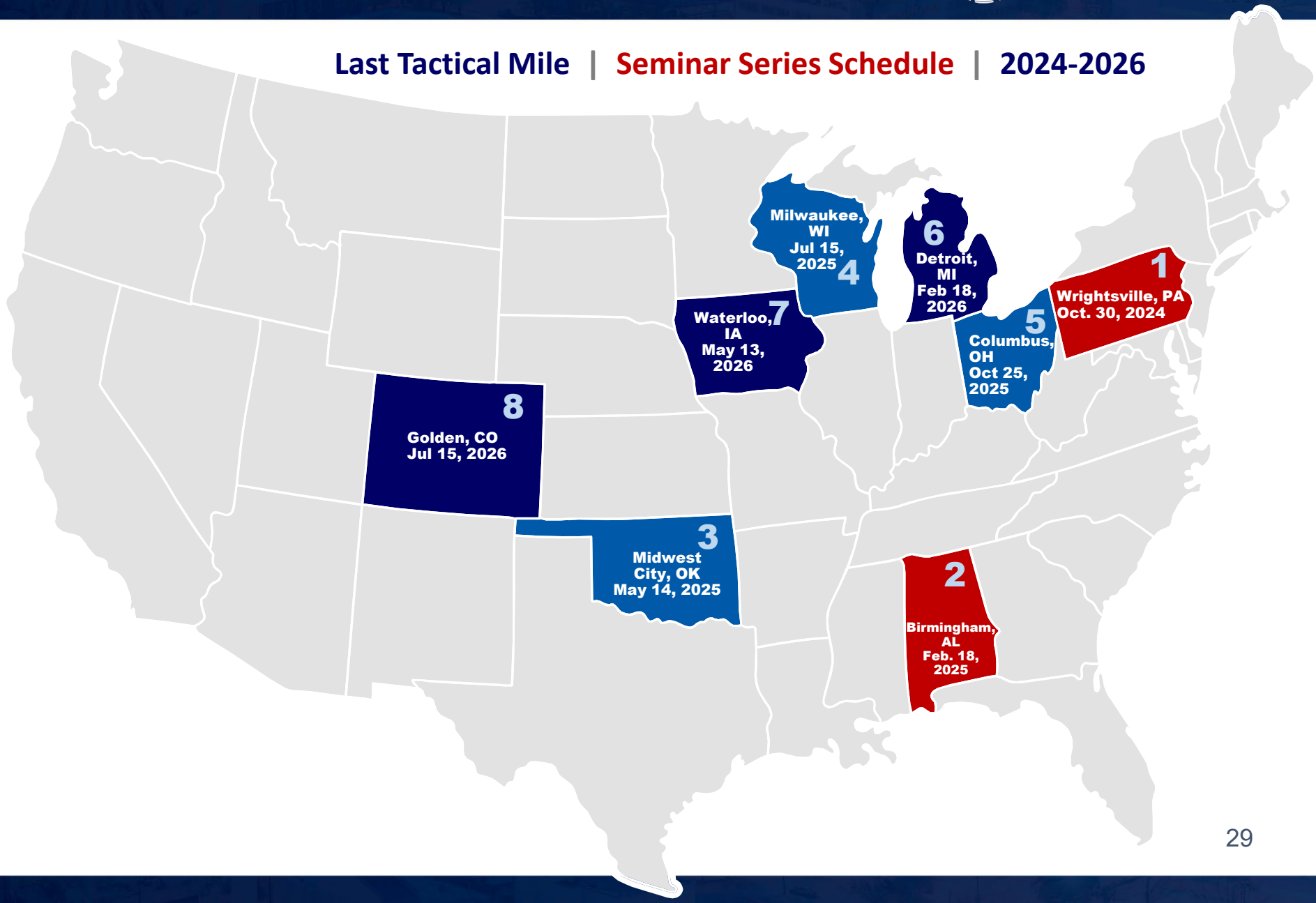
- to further inform and educate foundry technical personnel regarding best practices in the utilization of additive manufacturing technologies
- to facilitate discussion between workshop participants
- to foster an understanding of current and emerging AM technology applications

BEST PRACTICES SHARING

Last Tactical Mile Seminar Series

AFS CASTEXPO & METALCASTING CONGRESS

Last Tactical Mile Seminar Series Schedule	
1. Donsco Foundry; Wrightsville, PA	10.30.2024
2. Vulcan Museum; Birmingham, AL	02.18.2024
3. Rose State College; Midwest City, OK	05.14.2025
4. TBA; Milwaukee, WI	07.16.2025
5. OSU CDME; Columbus, OH	10.15.2025
6. TBA; Detroit, MI	02.18.2026
7. UNI Foundry 4.0 Center; Waterloo, IA	05.13.2026
8. Colorado School of Mines; Golden, CO	07.15.2026



Last Tactical Mile Seminar Series

CASTEXPO & METALCASTING CONGRESS

Defense Acquisition Professionals earn **7 Continuous Learning Points** (CLPs) for attending, contact Brittany Engel for details!

Earn 7 CLP credits, 8 Locations [2024 – 2026], at no charge!

Additive Manufacturing & Industry 4.0 technical solutions

[LTM] Impact 2.0 Seminar Series Schedule			
S1	10.30.2024	Donsco Inc.	Wrightsville, PA
S2	02.18.2025	Vulcan Museum	Birmingham, AL
S3	05.14.2025	Rose State College	Midwest City, OK
S4	07.16.2025	TBA	Milwaukee, WI
S5	10.15.2025	OSU CDME	Columbus, OH
S6	02.18.2026	TBA	Detroit, MI
S7	05.13.2026	UNI Foundry 4.0 Center	Waterloo, IA
S8	07.15.2026	Colorado School of Mines	Golden, CO

UPCOMING [LTM] SEMINAR EVENTBRITE REGISTRATION QR-CODES

S4	S5	S6	S7	S8
Milwaukee, WI July 16, 2025	Columbus, OH October 15, 2025	Detroit MI February 18, 2026	Waterloo, IA May 13, 2026	Golden, CO July 15, 2026

CONTACT **Brittany Engel,** Engineering Project Manager bengel@ybi.org HTTPS://YBI.ORG

IN PARTNERSHIP WITH America Makes

Last Tactical Mile SEMINAR SERIES

CASTEXPO & METALCASTING CONGRESS

1. **This seminar series provides VALUE to the domestic foundry industry by …**
   - increasing the **utilization of advanced manufacturing technologies** in metal casting applications
   - **increasing metal casting technicians' understanding** of additive manufacturing, binder jetting, material extrusion, machine optimization, etc.
   - utilizing **credible, respected industry experts** to …
     - ✓ inform and educate foundry industry technical personnel/supporting staff
     - ✓ share best practices/lessons learned from direct experience with these technologies

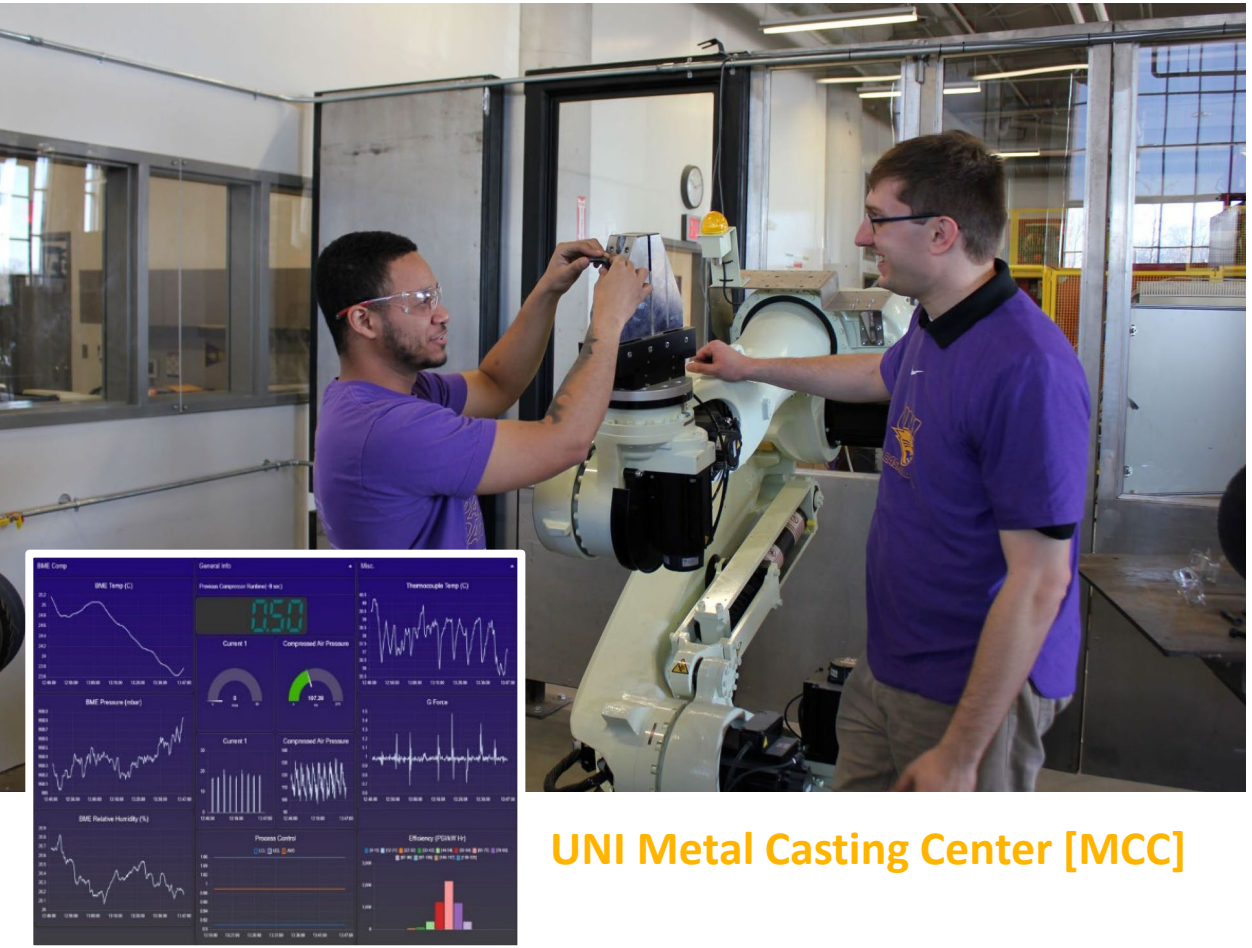
2. **The seminar series also seeks to INCREASE AGILITY/CAPACITY in the casting supply base by …**
   - increasing overall efficiency through a reduction in scrap and lead times, optimized equipment maintenance, economic operation of sand reclamation, part optimization/consolidation, etc.
   - reliably optimizing the environment for workers and compliance with environmental regulations
   - increasing foundry revenues through improved productivity, increased production capacity and decreased learning times

Accelerate industry uptake of **I4.0 technologies** with a high potential to provide business value

University of Northern Iowa

Two **UNIVERSITY OF NORTHERN IOWA** centers with one Mission: to AID student and staff RESEARCH & EDUCATION

UNI's MCC & F4.0 Centers



UNI Metal Casting Center [MCC]

UNI Foundry 4.0 Center

UNI's MCC & F4.0 Centers

UNI Metal Casting Center [MCC]

Nationally Recognized Leader: Over 25 years of excellence in foundry research, applied technology, and technical business assistance

Cutting-Edge Technology: Specializes in metal casting materials, processes, and 3D printing equipment to advance learning and innovation

Educational Hub: Provides hands-on experience and research opportunities for students and industry professionals

UNI Foundry 4.0 Center

Industry 4.0 Pioneer: Located at the Waterloo, IA TechWorks Campus, focusing on the latest technologies and processes for the manufacturing industry.

Collaborative Research: Partners with industry leaders and universities to enhance the adoption of advanced manufacturing technologies.

Student Opportunities: Offers part-time positions, research work, and internships for students from across North America.

UNI's MCC & F4.0 Centers

VISIT UNI IN BOOTH 650 ON THE EXHIBIT HALL FLOOR

AFS CASTEXPO & METALCASTING CONGRESS

Our Success STORIES

BEST PRACTICES

COMPANY #1

- 75+ year-old consumer products company, 100+ employees, located in Iowa, aluminum casting

COMPANY #2

- 110+ year-old (with a newer 10-year-old facility) contract casting services company, 60+ employees, located in Nebraska, steel casting plus a large range of alloys and casting sizes

COMPANY #3

- 80+ year-old investment casting company, 500+ employees, located in Wisconsin, customer engineering & metallurgical support in multiple markets (including A&D) with diverse alloy capabilities

Success STORY #1

COMPANY #1

Company Details

- A 75+ year old, family-owned business located in Iowa
- Producing 100% American-made products
- Known for its solid aluminum handles and lifetime guarantee on its cutlery

Problem statement

- Experiencing **higher than expected scrap rates** and **reduced production efficiency** due to a inexperienced new employees

Solution selected

- **Small box IoT systems (sensors & analytics)** were designed for easy integration with the existing furnace control systems, minimizing downtime during installation and ensuring a seamless transition
- **Thermocouples and environmental sensors connected to a Raspberry Pi** to allow continuous monitoring of key parameters
- **Real-time data collection** a on furnace performance to improve melting and casting process control
- Foundry operators use **data dashboards** to track temperature fluctuations and improve melting and casting process control and operational efficiency

Business value/impact

- An immediate **reduction in scrap rates** … more predictability and repeatability resulting in fewer defective parts
- A significant **increase in overall efficiency** through reduced scrap rates, increased production capacity, decreased learning times

A MORE COMPETITIVE POSITION IN THE MARKETPLACE AND AN ROI OF JUST A FEW MONTHS

Success STORY #2

COMPANY #2

Company Details

- 110+ year-old company located in Nebraska
- New facility 10 years ago
- Large range of alloys and casting sizes

Problem statement

- **Pressure differential monitoring required** for environmental air permitting in new facility

Solution selected

- **IIoT (Industrial Internet of Things) solution developed** to monitor and record the reclaim sand silo pressure differential
- BME280 sensors paired with a Raspberry Pi processing unit
- **Sensor data collected** sent by messaging broker to a locally hosted server, a Windows virtual machine
- **Streamlined, customized dashboard developed** to provide a simple to interpret user interface

Business value/impact

- Successful implementation of an IIoT solution ensuring **reliable compliance with environmental regulation**.
- Data collected has been utilized by operations and maintenance teams to **validate proper equipment operation**
- In addition, the data has provided a **clearer picture of how to economically operate the reclaim sand** transport system

THE COMPANY PLANS TO CONTINUE WORKING WITH THE UNI F4.0 TEAM TO FURTHER IMPLEMENT IIOT

Success STORY #3

COMPANY #3

Company Details

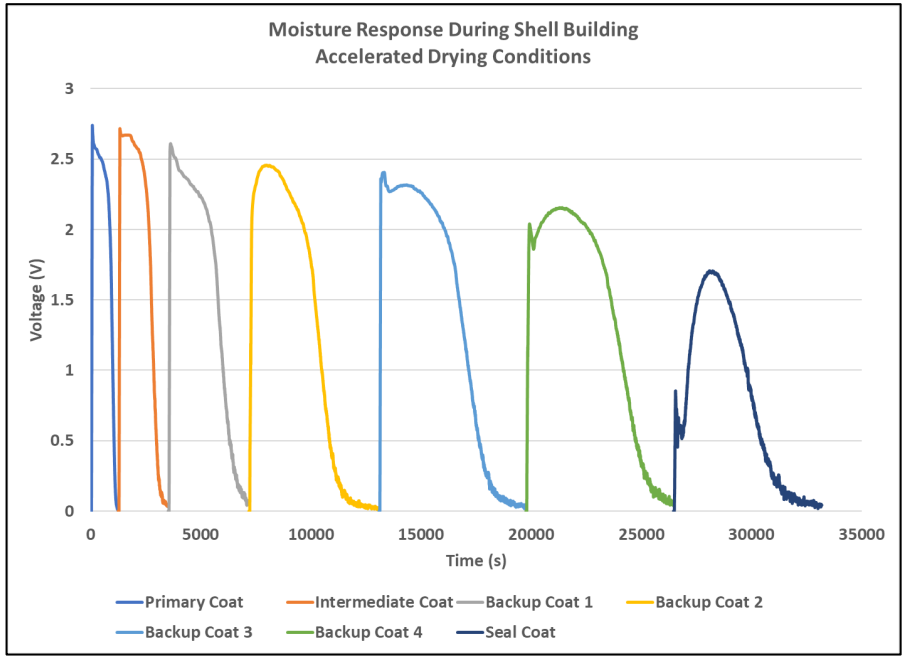
- Investment caster located in Wisconsin
- Diverse alloy capabilities
- Multiple markets including aerospace and defense

Problem statement

- Wanted to **optimize shell building sequence**

Solution selected

- **Temperature, moisture, and environmental sensors** were placed on a wireless board to measure shell dryness
- Board **utilized deep sleep mode** to extend battery life
- **Sensor data collected** sent by messaging broker to a locally hosted server, a Windows virtual machine
- **Dashboards provided** to monitor shell moisture in real time



Business value/impact

- **Ability to optimize drying conditions** to improve productivity
- Newfound **access to the relationship between environmental conditions and shell building**
- **Data could be used to inform future investments** in robotic dipping and drying

THIS COMPANY IS EVALUATING DATA THAT HAS NEVER BEEN SEEN IN PRODUCTION BEFORE

Executive SUMMARY

- The foundry & casting industries are under **intense performance pressure** today
- These industries are **highly impactful** to the United States **economy**
- The industries are **IMPORTANT** to the United States **manufacturing backbone**, **future industrial innovation** and **workforce skills development**
- Industry 4.0 technologies can provide **business value** and improve **resiliency**
- There is **ongoing work occurring** to demonstrate I4.0 technologies and their impact to a business' bottom line

CREATING VALUE THROUGH CHANGE

FOUNDRY & CASTING INDUSTRY

A RESILIENT FUTURE…

CASTEXPO & METALCASTING CONGRESS

For additional information, please contact:

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UNI University of Northern Iowa. Business & Community Services

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