Smart Manufacturing
Industrial Internet of Things (IIoT)
Roadmap for Northeast Ohio

EXECUTIVE SUMMARY
2019

Prepared by

IIoT Leadership Team
**Introduction**

Today the term “Internet of Things” (IoT) has become increasingly discussed in the context of improving business operations. IoT is about generating new data, aggregating them from multiple sources, sharing them, and analyzing the data to generate keener insight and better behavior. IoT applied in manufacturing is referred to as Industrial IoT (IIoT).

The purpose of the Smart Manufacturing Industrial Internet of Things (IIoT) Roadmap for Northeast Ohio is to establish a regional IIoT commercialization strategy, tactical framework and plan of action. This roadmap represents a vision and goals derived from a collaboration of several regional stakeholders.

This document provides background on the Internet of Things (IoT) and why a sub-segment known as the IIoT is one of the best opportunities to impact the prosperity of the NEO region.

**Road Mapping Process**

The road mapping process employed is Team NEO’s InSeven® model. This model is designed to identify key regional strengths as the basis of long-term regional development opportunities surrounding those assets.

The first half of the process “Where We Are Now” deals with defining and setting up the road mapping project and assessing current conditions of the IIoT market and regional asset space. During this phase, a substantial number of market studies and industry intel were canvassed and nearly fifty voice of the customer (VoC) surveys were collected. The information is then used to populate a value chain model and to validate the needs of the region.

The second half of the process “What is Possible” deals with outlining the potential for growth opportunities in the targeted IIoT market segment. After comparing other competitive regions to NEO’s IIoT strengths and capabilities, a NEO IIoT growth strategy and tactical implementation plan was formulated and approved by the Working Group.

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**Team NEO InSeven® Road Mapping Process**

1. **Plan for launch:** define scope, convene Working Group participants, “kick off”
2. Define subsectors, technologies, products; determine “core” vs. “supporting” value chain elements
3. Catalog the region’s “core” assets; map to subsectors; identify region’s critical mass and determine focus subsectors
4. Define market segments; quantify growth potential, drivers, and projections for the region’s potential participation
5. Identify top global & nationally competitive regions; assess to determine share potential
6. Based on insights, draft a 7-year plan to capitalize on strengths and opportunities
7. Syndicate plan throughout the region and revise as appropriate; finalize roadmap
Roadmap Working Group and Project Team

The Working Group members include representation from prominent end-user companies, key supply chain participants and leading academic institutions. The role of the Working Group has been to provide guidance and recommendations to the Project Team throughout the Roadmapping process.

### WORKING GROUP

<table>
<thead>
<tr>
<th>MEMBERS</th>
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<tr>
<td>Jennifer Bennett</td>
<td>Amazon Web Service</td>
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<td>John Colm</td>
<td>Wire-NET/ Manufacturing Works</td>
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<td>Marvin Davis</td>
<td>Arconic</td>
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<td>Tony Hughes</td>
<td>The Lanterman Group</td>
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<td>Andrew Jones</td>
<td>MCPc</td>
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<td>David Knowles</td>
<td>Rockwell Automation</td>
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<td>Mike Laurich</td>
<td>Parker Hannifin</td>
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<tr>
<td>Ken Loparo, PhD</td>
<td>Case Western Reserve University</td>
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<tr>
<td>Dave Moon</td>
<td>Hitachi Vantara</td>
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<td>Milind Paranjape</td>
<td>JobsOhio</td>
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<td>Mike Regelski</td>
<td>Eaton Corporation</td>
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<td>Bob Scaccia</td>
<td>USA Firmware</td>
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<td>Ryan Schnell</td>
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<td>Nigamanth Srithar, PhD</td>
<td>Cleveland State University</td>
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<td>Tim Sweeney</td>
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<td>Greg Ulm</td>
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<td>Joe Work</td>
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<td>Ed Yenni</td>
<td>LogiSync</td>
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<tr>
<td>Kelly Zelesnik</td>
<td>Lorain County Community College</td>
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### PROJECT TEAM

- **Jacob Duritsky**  
  Vice President, Strategy and Research  
  IIoT Roadmap Project Manager  
  - Team NEO

- **Marion (Rick) Earles**  
  Senior Director, Industry and Innovation  
  - Team NEO

- **Jay Foran**  
  Senior Vice President, Industry and Innovation  
  IIoT Roadmap Project Leader  
  - Team NEO

- **Tim Fahey**  
  Vice President, Industry and Innovation  
  - Team NEO

- **Tony Hughes**  
  Founder & President – The Lanterman Group

- **David Knowles**  
  Digital Transformation Accelerant  
  - Rockwell Automation

- **Sydney Martis**  
  Associate, Research  
  - Team NEO

- **Melinda McNutt**  
  Program Manager, Industry and Innovation  
  - Team NEO

- **David Moon**  
  Sr. Solutions Consultant  
  - Hitachi Vantara

- **Joe Work**  
  Senior Growth Advisor – MAGNET: The Manufacturing Advocacy and Growth Network
Why Focus on IIoT in Northeast Ohio?

Manufacturing is an essential component of NEO’s economy, and is projected to continue growing in the future. Accounting for more than one fifth (21%) of the region’s total gross regional product (GRP), the sector has seen productivity growth of 92% between 1990 and 2015, with an additional 73% productivity growth projected by 2025. To maintain our competitiveness in a global economy, innovation will become increasingly important to how we manufacture, both the products we produce and the processes we employ. IIoT offers an opportunity to gain an additional competitive advantage in manufacturing and change the growth trajectory of the sector even more significantly moving forward.

Potential IIoT Impact on NEO

To gain the benefits of IIoT, NEO’s current manufacturing base will need to change their processes and how they work. According to Moody’s Economy.com projections, Northeast Ohio’s manufacturing GRP is projected to grow approximately $4 billion from $45 billion in 2018 to $49 billion by 2025. Based on calculations utilizing McKinsey Global Institute Data and Accenture estimates, IoT’s application in a factory setting such as IIoT in the manufacturing sector has the potential to grow GRP beyond the current projection of $49 billion to $52 billion in 2025. The higher end of the potential impact IIoT will have on NEO’s manufacturing sector by 2025 is $62 billion dollars.
Northeast Ohio Economic Impact by Application Segment

According to the estimate provided by McKinsey, Northeast Ohio has the potential to receive an economic impact of between $3.5 and $10.1 billion annually in year 2025 from the implementation of IoT in various manufacturing application segments. This projection is based on a model that assumes that the applications of IoT will create a new surge of factory productivity.

Northeast Ohio Potential Economic Impact by Application Segment

Operations Optimization
- Lower: $0.2 - $0.8 B
- Upper: $2 - $6 B

Predictive Maintenance
- Lower: $0.3 - $1 B
- Upper: $0.8 - $2 B

Inventory Optimization
- Lower: $0.3 - $1 B
- Upper: $0.8 - $2 B

Health and Safety
- Lower: $0.2 - $0.8 B
- Upper: $0.8 - $2 B

Source: McKinsey Global Institute data analyzed by Team NEO
### SWOT - The IIoT Opportunity for the NEO Region

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
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<tr>
<td>• Manufacturing – Industrial Legacy creates large market size – A+ Pool of Seeker Companies</td>
<td>• Level of Software System Development</td>
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<td>• Instruments, Controls, Electronics Expertise – both industry leaders and strong start-ups</td>
<td>• Data Analytics Expertise</td>
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<td>• Application Match with Seeker Need</td>
<td>• Legacy manufacturing machinery raises ROI challenge</td>
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<td>• Global Leaders with HQ &amp; Technology Hubs here</td>
<td>• Lack of innovation Center of Excellence</td>
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<td>• Lack of capital support to fund innovation</td>
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<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
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<td>• Institutional Leadership (e.g. IOT Collaborative, NASA) can baseload Center of Excellence for region</td>
<td>• Global competition</td>
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<td>• Accelerate rate of digital transformation</td>
<td>• Lack of C-level buy-in and organizational budget commitment</td>
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<td>• Help bridge labor shortage</td>
<td>• Better coordinated and funded industry – institutional strategy by another USA region</td>
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<td>• Multiple technologies are converging (e.g. AI, VR)</td>
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The analysis contributed to the commercialization framework that produced the vision and goals noted below.

**Vision**

Accelerate growth in the Northeast Ohio economy through the implementation of industrial IoT that leverages the region’s rich manufacturing heritage, unique assets and talented workforce.

**Goals**

- Drive demand for Industrial IoT
- Increase regional productivity
- Spur product innovation
- Develop resources to support Industrial IoT implementation and innovation
**Voice of the Customer (VoC) Findings**

The future success of IIoT in Northeast Ohio depends on the perceptions of the regional manufacturing companies as much as it does on objective statistical analysis. For this reason, nearly 50 companies comprising Northeast Ohio’s IIoT’s supply chain were interviewed during this Road Mapping process.

**IIoT Demand Side – Implementation of IIoT**

Select findings from VoC interviews of manufacturers that seek to implement IIoT into their operation and the organizations that provide the services:

- A majority of the small to medium size manufacturers in NEO want more information on the potential impact of IIoT on their business. Specifically, as it pertains to their operations, they can be sensitive to risk and desire having a greater understanding of their business transformation before embarking on the journey to smart manufacturing.

- In general, larger manufacturers have a more mature understanding of the potential impact of IIoT on their business but require a higher degree of customization for their implementation. Numerous respondents indicated that they are skeptical of the hype of IIoT and are finding the required effort of implementation to be much greater than what they had anticipated.

- There exists a wide array of companies in NEO that can play the role of IIoT solutions provider to assist both large and small businesses with their efforts to implement IIoT into their operations. However, a match making process would assist manufacturers and the solution providers to more easily find a way to harmonize the IIoT project needs and establish a collaborative engagement.

- Top application areas are overall equipment efficiency (OEE)/operations optimizations, predictive maintenance, and supply chain efficiency/inventory optimization. Safety was not a major application for IIoT, however, the companies that did note safety as a reason for IIoT were highly passionate about this application.

**IIoT Application Areas by Demand-side Seeker Voice of Customer Interview Responses**

- Operating Efficiency
- Predictive Maintenance
- Product Quality
- Supply Chain Management
- Inventory Control
- Occupation/Worker Safety

Source: IIoT VoC responses

**IIoT Supply Side – IIoT Product Innovation**

Several findings from VoC interviews of IIoT product OEMs/service providers and the supply chain of organizations with advanced capabilities that participate in IIoT related product innovation:

- Because of NEO’s legacy with the instruments, electronics and controls segment, there is a deep supply chain of companies and institutions that are well equipped with products for, and versed in, connected devices and control systems for manufacturing. The challenge is to expand these capabilities to include big data, data analytics, artificial intelligence, and cybersecurity.

- Several highly specialized companies in NEO have capabilities in advanced data analytics, embedded intelligent controls, and data management and provide a basis for a supply chain that IIoT product OEMs can rely on for a source of product innovation.

- There is an ever-increasing need for graduate and post-graduate engineers in the fields of electrical engineering, data sciences, and manufacturing engineering. A more urgent acute skills need are recent graduates with application experience in operational technologies (OT).
Supporting Resources – Skills & Training Needed to Support IIoT Implementation & IIoT Product Innovation

Organizations that are part of both IIoT implementation and IIoT product innovation were asked what their critical needs were relative to employee skills development and workforce training. Following are some of the key findings:

• Generally, the manufacturers implementing IIoT into their operations need assistance re-training incumbent workers to become proficient with OT and recruiting experienced personnel with advanced capabilities to help with the implementation, care, and feeding of the IIoT system.

• The organizations that are continuously infusing new IIoT related features into their products, and the supply chain that support their efforts, need assistance recruiting both graduate and post graduate employees through internship programs that expose the personnel to popular IIoT applications and related software and hardware products. Advanced degrees tempered with connected smart systems experience is essential.

• A request mentioned by a majority of the VoC interviewees was to implement a one stop shopping service/clearing house for qualified applicants that identifies and promotes available internships.
NEO IIoT Roadmap Commercialization Plan Framework

The NEO IIoT Roadmap Commercialization Plan Framework provides the starting point for defining strategies in three key areas for the Smart Manufacturing Cluster: implementation of IIoT, IIoT product innovation, and skills training/workforce development. These key areas were identified through the collaboration of the Roadmap Project Team and Working Group.

**Smart Manufacturing Cluster:** a leadership function for the implementation of the Commercialization Plan that includes; program management, marketing, outreach, entrepreneurship, and business attraction.

**Implementation of IIoT:** break down obstacles to integrating smart manufacturing into business operations and grow companies that supply products and services in support of an IIoT solution.

**IIoT product innovation:** expand advanced IIoT features supplied by IIoT products/services providers and promote collaboration around advanced technical capabilities.

**Skills training/ workforce development:** leverage smart technology related skills organizations for IIoT product innovation and carry out initiatives that create an IIoT workforce pipeline.

Source: Roadmap Working Group
**Initiatives**

**Implementation: Drive demand for IIoT implementation.**

1 / Develop a portal hosting a database of case studies and supporting information to provide context around IIoT implementation. Solvers provide success case studies to help drive seeker demand.

2 / Follow up the IIoT Roadmap by exploring different approaches to implementing IIoT through either a top down or bottom up strategy.

3 / Establish working groups surrounding high IIoT implementation application areas: operating efficiencies, predictive maintenance, and supply chain management. Identify mechanisms for aligning suppliers with these applications.

4 / Expand upon the Roadmap market research to capture the potential economic impact on IIoT solution providers.

5 / Distribute the IIoT Readiness Assessment Tool to the regional manufacturing community; deliver relative scoring confidentially to companies; and promote summary of collective findings throughout the region.

**Innovation: Spur advances in IIoT product innovation.**

1 / Explore the next generation of enabling technologies based on trends such as embedded intelligence, cyber security, edge computing, and data processing.

2 / Grow partnerships to connect the solvers to offer customized solutions to seekers.

**Resources: Support programs with institutions that create the specialized intellectual capital that enable IIoT implementation and innovation.**

1 / Advance talent development through experiential learning:
   - Expand workforce through innovation hubs (supply).
   - Produce internship opportunities to create workforce pipelines (demand/supply).

2 / Spur future collaboration between stakeholders to advance training and curriculum development to create the next generation of an IIoT proficient workforce.

3 / Understand the credentialing requirements of an IIoT workforce and integrate it into future regional talent supply demand analysis.

**Grow the Smart Manufacturing Cluster**

1 / The development of the Smart Manufacturing Cluster of seekers and solvers to support Northeast Ohio’s IIoT commercialization plan.
   - Establish a shared leadership model to implement NEO’s IIoT Commercialization Strategy.
   - Attract investment to and promote awareness of programs to foster start-ups and encourage entrepreneurialism surrounding IIoT product innovation.
   - Collaborate on training and workforce development initiatives.
   - Encourage the attraction of companies engaged in IIoT product innovation to advance the region’s applications of embedded intelligence, cyber security, edge computing, and data processing.
The Internet of Things Collaborative

The Internet of Things Collaborative is a unique regional public-private academic collaboration between Cleveland State University and Case Western Reserve University and funded by The Cleveland Foundation. The Collaborative is focused on advancing the state of the art and practice in the IoT in manufacturing, energy, health, and infrastructure/Smart City sector and building an IoT hub in Northeast Ohio.

The IoT Collaborative’s initiatives surround higher education, industry outreach, public sector outreach and economic development. This partnership will expand research and educational opportunities in the emerging technology of the IoT through the development of transdisciplinary research partnerships across the universities, new courses, student exchanges, and partnering with third-party economic development initiatives.
Where is Your Company on the IIoT Journey?

Take the Complimentary IIoT Readiness Assessment

The IIoT Readiness Assessment was developed collaboratively by the Roadmap Project Team and Working Group to be used as a tool to help a company evaluate its digital maturity and readiness for IIoT implementation. The focus of the assessment is on key readiness indicators including:

• Level of Engagement
• Organizational Support
• Potential uses for IIoT
• Workforce Readiness
• Digital Maturity

All survey responses are confidential, complimentary and will be analyzed by the Roadmap Project Team and returned to those surveyed to provide a high-level assessment of your organization’s readiness to adopt IIoT solutions, and how your readiness compares to others in the Northeast Ohio market.

Visit bit.ly/NEOIIoTRoadmap to take the IIoT Readiness Assessment

For additional information, connect with:

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