

THE STATE OF IoT

2019 INAUGURAL EDITION

THANK YOU TO OUR SPONSORS



SECTION 1
INTRODUCTION

4 | Letter from the Governor

5 | Letter from the Mayor

6 | Letter from the CEO

7 | IoT Lab in Review

SECTION 2
THE THREE PILLARS OF THE INDIANA ECONOMY

MAKE THINGS

16 MANUFACTURING

As a state, Indiana remains at the top of per capita employment for manufacturing with more than 500,000 Hoosiers classified as working in Advanced Manufacturing.

18 | Indiana IoT

22 | Flexware Innovation

24 | WPR Services

26 | ValleyHop

MOVE THINGS

28 LOGISTICS

Known as the "Crossroads of America," Indiana ranks in the top 10 among 46 significant logistics-related categories across the country.

30 | Conexus

34 | enVista Corporation

36 | FreightRover

GROW THINGS

38 AGRICULTURE

Indiana ranks in the nation's top 5 for a variety of crop and livestock categories, devoting more than 14 million acres to 60,000 farms.

40 | AgriNovus

42 | Beck's Hybrids

44 | The Bee Corp & Spensa Interview

SECTION 3

THE CONVERGENCE OF TECHNOLOGY

The commercial building and home automation market is growing at a significant rate, serving as a foundation for the smart cities of the future.



50 | Allegion

54 | Ultimate Technologies Group

56 | Omni Automation

SECTION 4

THE BUILDING BLOCKS OF IOT

Data collection and analysis, legal considerations, identification of consumer needs through Design Thinking, and cybersecurity are all critical components of any IoT project.

 **MACHINE LEARNING**

 **DATA**

 **LEGAL/IP**

 **IDEATION**

 **SECURITY**

60 | ClearObject

62 | Indiana University

68 | Ice Miller

74 | Roche

82 | KSM Consulting

66 | Predictive Partners

78 | Outside Source

67 | StratoStar

80 | CreateAbility

SECTION 5

FUTURE VISION OF IOT IN INDIANA

Integrating world-class IoT skills to capitalize on the rich history of expertise and leadership throughout our state, we can change entire industries and ultimately change the world.

86 | Future Vision of IoT



LETTER FROM THE GOVERNOR

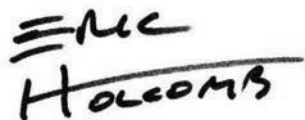
Over the last decade plus, Indiana has made a strategic effort to diversify our economy; leveraging our strengths in advanced manufacturing, logistics, agbioscience, and technology to attract more entrepreneurs to the Hoosier State. Our efforts are bearing fruit as we're setting job commitment records, earning national accolades for our business climate, and have more Hoosiers working today than at any other time in our state's history.

These achievements wouldn't be possible without facilities like the IoT Lab, which provides entrepreneurs a unique opportunity and resources to develop new ideas that will keep driving Indiana forward. As other states imitate our Indiana Blueprint in their efforts to catch up, it's more important than ever we support and champion the very best of innovation in Indiana.

As you read through this publication, you'll find there's much to celebrate, and you'll learn what Hoosier thought leaders, entrepreneurs, and global innovators have in store for the future of IoT. I invite you to join in the discussion.

It's an exciting time to be a Hoosier! To keep the pole position in our race against the competition, we need to build upon this spirit of innovation, grow our IoT network, and continue to attract and retain the best and brightest minds in these fields.

Sincerely,

Handwritten signature of Eric Holcomb in black ink, featuring a stylized 'E' and 'H'.

Eric Holcomb



ERIC HOLCOMB
Governor

State of Indiana
State House, Second Floor
Indianapolis, Indiana 46204

LETTER FROM THE MAYOR

Nearly two years ago, we announced the idea of creating a lab at the center of Fishers' Certified Tech Park as a hub of innovation for the Internet of Things in Indiana. Today, this report shares the progress we've made in a relatively short amount of time to place Indiana at the forefront of the next generation of disruption.

Indiana's economy relies on generations-long, traditional industries: manufacturing, agriculture, and distribution. These industries have solidified their place in America's Heartland for a reason. The Midwest has always been home to great innovations like the first gas-powered automobile, the first cell phone, and the assembly line. Industry-changing innovations should be no different.

We make things, grow things, and move things, and as technology disrupts these key industries, it's investment in programs and places like the Indiana IoT Lab that will be critical to fostering innovation for the sustainability of our future generations.

Our work here is just getting started. As I've said before, I challenge you to seize the chance to create an economy that provides economic opportunity and upward mobility for generations to come. It all starts here in Fishers.

Yours in service,



Scott A. Fadness



SCOTT A. FADNESS
Fishers, Indiana Mayor

LETTER FROM THE CEO

By investing in infrastructure, programs, and development initiatives supporting the IoT ecosystem, Indiana is poised to lead the next generation of industry. Capitalizing on our rich entrepreneurial heritage and history of leadership in several key industries, the Indiana IoT Lab in Fishers is a collaboration of forward-thinking leaders and organizations from across the state, including Indiana University, Comcast Business, and Allegion. These partners, in conjunction with Launch Fishers, the Indiana Economic Development Corporation (IEDC), Mayor Scott Fadness, and the City of Fishers helped give rise to the first city-funded IoT lab in the nation. I'm grateful for these leaders and organizations, along with many others, who are championing the cause.

The Indiana IoT Lab is thriving, but the quest is far from over. Our goal is to create a statewide network of IoT innovation hubs, removing barriers to our entrepreneurs, improving statewide collaboration, and building IoT capabilities into traditional strengths. Each Indiana community has something unique to offer, and these hubs will provide an environment for thought-leaders to connect and develop solutions to meet the world's growing tech needs. With ideation spaces, cutting-edge equipment, and a focus on collaboration, the Indiana IoT Lab Network will be positioned to make Indiana the State of IoT.

Sincerely,



John Wechsler



JOHN WECHSLER
Founder and CEO

The Indiana IoT Lab

BRINGING TOGETHER THE INTERNET OF THINGS (IOT) IN FISHERS, IN

BY JASON PENNINGTON | EXECUTIVE DIRECTOR, INDIANA IOT LAB

Although the broader Indiana Coworking Passport connects nearly 50 coworking locations around the state, there was something missing for the emerging tech sector. Specifically, the IoT-centered developers and makers who needed a lab space to build, test, and fail were underserved in the traditional co-working space. Resulting from a collaboration of local government officials, entrepreneurs, and established IoT business leaders in 2016 to overcome this challenge, the initial IoT Lab concept began.

From these sessions, the operational pillars of make things, move things, and grow things emerged. With a focus on Manufacturing, Agriculture, and Distribution, the founding group developed a business plan, secured a space where entrepreneurs could incubate, and communicated a shared vision. This plan differed from other examples in that the individual entrepreneur and start-up company would be immersed in an environment with established firms and outposts of global entities.

“We wanted to align the labs focus to those industries Indiana depends on: Manufacturing, Agriculture, and Logistics.”



TECH SUCCESS IN INDIANA

The Indiana Software as a Service (SaaS) economy has produced success stories such as Angie's List, ExactTarget, and Aprimo. The sector received its strongest vote of confidence in early 2017 when the Salesforce.com Cloud took front and center in the Indianapolis skyline among the likes of Eli Lilly, Simon Property Group, One America, and a myriad of sports stadiums and hotels.

While the SaaS economy in the state continues to grow, organizations like High Alpha have grown beyond their initial \$35 Million rounds to produce a second \$100 Million round in 2018 to become one of the largest venture studios for enterprise software in the world.

WHY NOT SUCCEED WITH IOT IN INDIANA?

The Internet of Things places hardware, software, application development, and data in our everyday lives. Our state excels in core industry sectors ripe for some of the largest IoT disruptions. We have a robust environment for entrepreneurial opportunity and support. 2018 saw an 8th Hoosier company join the Fortune 500. We have an evolving network of tech focused organizations such as the Central Indiana Corporate Partnership (CICP). We have nationally ranked universities specializing in business, engineering, computer science, and pioneering Informatics programs offering a multi-disciplined approach to world-changing topics. With a healthy corporate business climate rooted in manufacturing, agriculture, and logistics, a renowned university system, and a developed pipeline of SaaS talent and venture economy in place, Indiana is positioned to become the State of IoT.



VISION TO ACTION

The Indiana IoT Lab in Fishers opened its doors on March 21, 2018. Nearly 1,000 attendees were introduced to the founding sponsors and key stakeholders from the community. With marquee sponsorships from Indiana Economic Development Corporation, Allegion PLC, Comcast Business, Indiana University, and the City of Fishers, the ceremony launched a mission to bridge gaps in the Indiana Tech economy, support some of the states most important industries, and provide a conduit for IoT thought leaders to actively participate in this increasingly digital economy.

Seven tenant companies were housed in the lab as its foundation, with an immediate opportunity for “small firms to think big.” Established Fishers, Indiana firms Flexware Innovation and ClearObject have nearby operations with teams of more than sixty employees, and bring proven industry expertise and engaged leadership with smaller, agile offices in the lab focusing on connected hardware and cloud solutions. Indianapolis firm Indesign, LLC., a full service electro-mechanical design company, also created a targeted IoT-focused outpost onsite.

Outside Source has continually adapted their business for more than thirty years. To join the IoT lab, the company relocated their offices to Fishers in early 2018. The company merges both creative design and technical development teams with conceptual strategists to streamline user interfaces for increasingly smarter products and connected services. Novel Bits, LLC. provides Bluetooth® platform development and embedded architecture services, while Volktek designs and



markets industrial grade hardware, software, and networking platforms to support IoT and Industry 4.0 initiatives. Lastly, ShopperKraft VR develops and provides a platform and infrastructure for virtual reality, augmented reality, and 3D modeling to enhance interactions and user experiences.

In the weeks following the grand opening, the IoT lab began procuring equipment, working with additional sponsors, and developing a programming schedule. This inclusive build-out was focused on the current and prospective members, individual and companies alike. The building and equipment spaces were arranged to prototype, develop, and explore IoT technologies. Prototyping with basic materials like foam core, wood, plastic, and metal were made available in the lab by the end of September 2018. Test and measurement equipment, processor driven development platforms, and on-premise networks ranging from 5G and LoRaWAN™ were also installed.

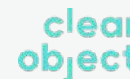
To showcase the converging sector of hardware, developer, and networking technologies, AT&T hosted a Civic Hack-A-Thon at the Indiana IoT Lab in April 2018. The event brought 500 people together to explore IoT solutions supporting the public safety network FirstNet. Additional cross-company events were held throughout the year in the form of targeted developer initiatives. Local technology consulting firm Centric and sponsor company Glassboard, a full service hardware development and design firm, hosted an IoT deployment workshop for an additional 40 developers in May. Comcast Business hosted Celebrity Chef Robert Irvine in September to raise awareness for IoT and the emergence of connected appliances in our everyday life. In October, Verizon Wireless hosted “The Future of Mobility,” a nationwide 5G campaign and technology roll-out. The final major developer day of 2018 showcased LPWAN and LoRa technology with Indesign, LLC. and Millenium Alliance Group with a chipset focus for Simtech and Murata, test



MARCH
2018

INDIANA IOT LAB GRAND OPENING

● First wave of tenants join the IoT Lab



● IoT Meetup for Hardware and Application Focus hosted

equipment stations with Copper Mountain Technologies, and device hosting with Comcast Machine Q. In total, more than 3,500 people have entered the Indiana IoT lab in less than a year.

Programming in 2018 was highly aligned to building a network of members, showcasing technology, and demonstrating why the environment for lab space needs to be different. Through hosted meetups, 400 people have attended topic driven monthly programs focused on IoT networks + hardware, blockchain + cloud, and legal aspects of data protection + business related topics.

OUTLOOK AND ADAPTING TO MARKET OPPORTUNITIES

As IoT evolves to become increasingly accessible beyond the application driven solution, the correlation between outcomes

and developers increases. With an expanding range of products, services, and use cases for connected technologies, the need to collaborate within a multi-disciplined development environment has never been more important. As adoption rates exceed billions of connected devices per year, the Ideation and Design Thinking programs provide outlets and methodologies to address the potential market opportunities for IoT.

Opportunity identification, collaborative problem solving, rapid prototyping, and a culture of cohabitation rather than coworking drives results. The idea of open innovation or lean innovation is not new to industry, but perhaps is being explored with increasing willingness in the context of IoT. As a function of ideation workshops with representatives from the local market, there is an observed range of companies with varying levels of digital readiness to prepare or continue to deploy IoT



APRIL
2018

● AT&T Civic Hack-A-thon



MAY
2018

● Centric/Glassboard IoT Workshop
● Blockchain Meetup Group hosted



JUNE
2018

● IoT Entrepreneur Meetup launched

2018 RESULTS AND IMPRESSIONS



50

IoT Inspired Events

We help entrepreneurs and start-up companies **EVOLVE** their ideas into businesses by providing space, equipment, and access to a broader network.



3,000

IoT Lab Visitors

We **ENGAGE** Indiana with programming, publication, and promotion designed to develop and align IoT technologies with the core economic pillars in our Hoosier economy- We help Make Things, Move Things, and Grow Things.



15+

On Premise Companies

We bring together existing companies that compliment and collaborate to **ENHANCE** technology opportunities for a diverse customer base.



JULY
2018

- Design Thinking sessions begin



AUG
2018

- IoT Lab recognized by the IEDC as one of the first IoT labs in the country



SEPT
2018

- Comcast Business hosts an Evening with Celebrity Chef Robert Irvine discussing IoT in the kitchen
- Prototyping Shop takes shape

technologies. As a lab network, the terms engage, evolve, and enhance are provided as descriptors for where we collectively see the regional market in 2018.

Closing a second wave of tenant development in 2018, the Indiana IoT lab welcomed many new faces. A lean innovation department from Roche Diagnostics, a Swiss-based life science company with Indiana-based US headquarters, joined as a corporate outpost to host development sprints and access a daily network of specialists in IoT disciplines. Ultimate Technologies Group, a smart building technologies provider, located their tech support and integration teams in the lab after acquiring Electronic Evolution. With the newly combined companies operating a corporate office and showroom, the IoT

Lab provided an ideal space for tooling, testing, and continuous development of their smart technology portfolio. 1st Maker Space, designer of STEM based programs, furniture, and accessories, located their functional Maker Space Showroom in the lab. Complete with laser cutting equipment, 3D Printers, and a variety of educational IoT solutions, the company provides valuable equipment expertise to stimulate tomorrow's entrepreneurs and technical talent base. The start-up company Qumulex officially incorporated from the IoT Lab and will launch their offering in the coming year. And finally, the Carmel, Indiana-based startup Omni Automation relocated their R+D operations to a unique, home-like testing environment within the 25,000 sq ft warehouse space at the lab. This co-sponsored environment provides an open source, real-world proving



**OCT
2018**

- Verizon Future of Mobility and 5G roadshow
- Second wave of tenants join the IoT Lab



**NOV
2018**

- First collaborative in-house projects kick-off
- LoRa Bootcamp and Developer Training



**DEC
2018**

- Universal Robots - CoBotting and Connected Manufacturing training
- Third wave of tenants join the IoT Lab

ground for connected device development and Omni's pursuit of the true, smart home.

PARTNERSHIPS AND OUTLOOK

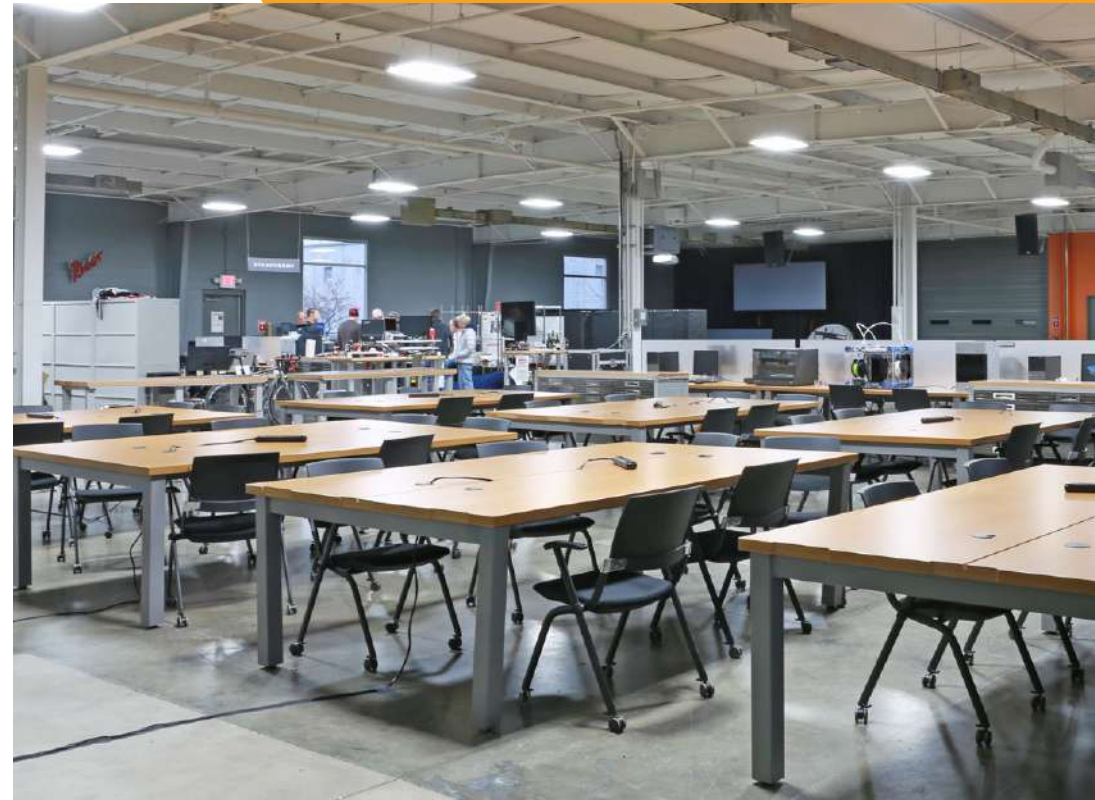
The Indiana IoT lab experienced success in 2018 and created a foundation with members and sponsors. We started building programs to attract visitors, creating interaction opportunities for members, sponsors, and regional businesses, and we utilized equipment to present minimum viable products to solve problems in our immediate community and beyond. In early Q3, the lab was recognized in a nationwide publication of International Economic Development Council, "Future Ready."

Second and Third Waves of Tenants to join the IoT Lab:



It can not be overlooked, however, that the IoT Lab in Fishers is not a single lab with expectations to serve a state. As you progress through this publication, you'll find the strength in the network which comprises the State of IoT consists of many thought leaders, industry experts, and entrepreneurs. Industry sectors, technology developments, supporting business topics, and legal domains are represented, with the Indiana IoT Lab's vision, commitments, and 2019 outlook serving as the conclusion. We will no doubt build upon 2018 with additional sponsors, members, and a growing sandbox to push IoT forward for Indiana.

Find out more – www.indianaiot.com



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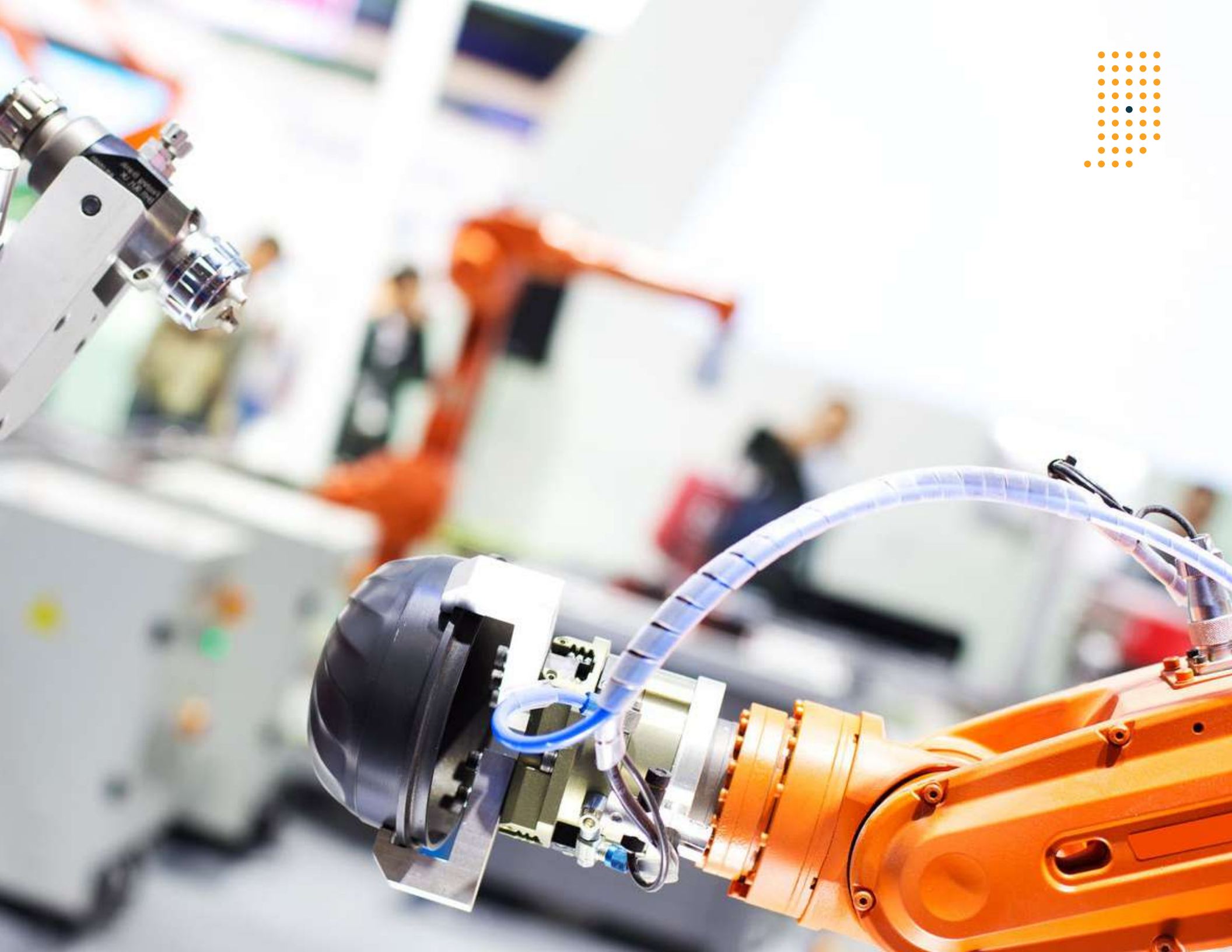
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MAKE THINGS



MANUFACTURING

In Indiana, we make things. We are a state of hardworking people contributing to the top ranking manufacturing industry in terms of GDP. We are making big strides in the industrial Internet of Things (IIoT). There are many activities, development initiatives, and evolutionary partnerships underway to advance manufacturing beyond what is possible and what is deployed.





AUTHOR:

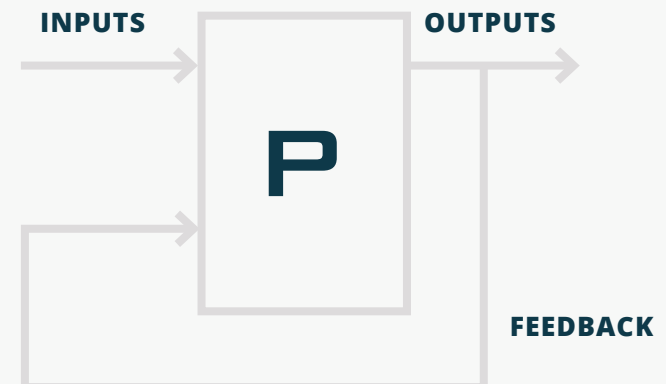
JASON PENNINGTONExecutive Director
Indiana IoT Lab

After leaving a twenty year career in manufacturing, automation, and process consulting serving some of the world's largest producers, Jason Pennington now serves as the Executive Director of the Indiana IoT Lab in Fishers, IN. In this role, the opportunity to dialogue and more importantly, process the feedback from a variety of local industrials offers a broad perspective for manufacturing in the Hoosier state.

ADVANCED MANUFACTURING AND PROLIFERATION OF THE INDUSTRIAL INTERNET OF THINGS REQUIRES A FEEDBACK LOOP

We make things in Indiana. A variety of things. We process metals, agriculture products, and plastics. We are instrumental to the nation's automotive industry. Life-changing medicines and world-changing technologies are derived here. In the midst of these highly marketable sectors are the basic needs and components often transparent in our lives yet vital to our comforts, imagination, and expectations as consumers.

About 20% of our population is involved in manufacturing. As a state, Indiana remains at the top of per capita employment for manufacturing with **more than 500,000 Hoosiers** classified as working in Advanced Manufacturing.



Terms like Advanced Manufacturing and Industry 4.0 seem vague to many, but there is a certain understanding throughout Indiana. With nearly 20% of our workforce involved in automotive industries, the acceptance of robotics and working knowledge of LEAN principles are commonplace. While this number is down from historic highs, the recession in the early 2000's could be viewed as a long term benefit to the variety of industries in the state. A downsizing in the automotive category created a redistribution of talent in the midwest as Michigan, Ohio, Indiana, and Illinois all played an important, historical role nationwide. These workers brought skills, ideas, and a renewed interest in continuous learning and acceptance of change to non-automotive focused companies.

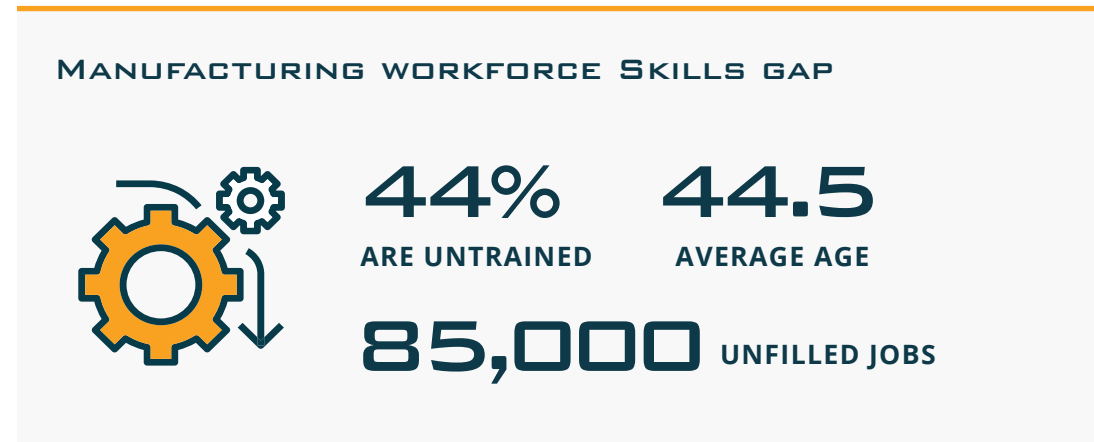
For the promise of Indiana as a top manufacturing state, more can be said about the desire to retain its competitive advantage. Throughout the state, there are many public-private initiatives, workforce training programs, and campaigns designed to reach our next generation through STEM activities and mentorships. These activities market manufacturing as a showcase career of engineering and technology rather than an occupation merely producing the means to live.

These programs are vital to the success of future manufacturing. Most companies, Indiana or elsewhere, are not Eli Lilly, Cummins, Steel Dynamics, Zimmer Biomet, or Berry Global. While these Indiana manufacturers are Fortune 500 powerhouses with global reach, the majority and future of Indiana manufacturing is represented by the other 7,000 listed manufacturing companies in the state. Along with major employers like Rolls-Royce, Roche Diagnostics, Allison Transmission, and Allegion PLC, Indiana manufacturers face real challenges to remain competitive in the years to come.

By some accounts, the future of manufacturing is challenged by what is possible versus what is deployable or attainable in today's environment. These feedback loops range from available skilled labor to trusting a fragmented app for that infrastructure. No matter if a manufacturing facility is reliant upon manual labor or automation, a basic production standard is every process has an input and an output. For the short term, in spite of the promises of the Industrial Internet of Things (IIoT), there are basic realities that produce roadblocks in the value stream map between current state and navigating towards Digital Kata – the potential future state.

SHORT TERM

Short term current state manufacturing ranges from highly manual to advanced hybrids of people and automation. Manufacturers with a history and culture of LEAN tool sets have been more likely to cautiously adopt connected technologies and embrace the IIoT. A common theme in today's narrative relates to a basic input of production – labor. The topic of labor ranges from commentary



concerning an aging workforce and the documented flight of boomers into retirement and the skills gap created by decades of engineering the process rather than engineering the workforce.

In other words, automation and technology has been continuously engineered, designed, and adopted into the manufacturing sector to improve safety, productivity, and reliability. At the same time, this technological adoption and automation has been impeded, in part, by labor. While it is easy to suggest automation minimizes manual labor, it is equally important to understand automation requires manual intervention, skilled labor, and modernized problem solving skills.

WHAT IS POSSIBLE AND WHAT IS DEPLOYED

Today's connected technologies in the manufacturing sector serve to support core processes. These supporting processes represent supply

chain, utilities, upstream feedstocks, and post production processes. Connected sensors, drives, scanners, vision, and various other automation components are providing additional and supplementary multivariable inputs to local controllers. In a classical sense, the decentralized control systems that have existed since the analog age are constantly improving and becoming more digital in nature. These enhanced data opportunities are bridging and visualizing customer demand through the traditional, IT dominated ERP systems (Enterprise Resource Planning) and increasingly reaching various layers beyond the plant floor and through the supply chain. These adoptions are the accepted and well-known connected experiences forming a basis for the Industrial Internet of Things.

While there is growing integration above the MES layer (Manufacturing Execution System) and examples of machine learning, artificial



intelligence, and big data, the feedback loops suggest more common integrations today are rooted in the increasing dependence and augmented capabilities of external service providers, while inhouse engineers work on pilot scale activities and reliability studies. Although parallel systems, portals, and plug-ins dominate the current system infrastructure, cultural acceptance of external partner deployment presents an immediate opportunity to support advanced manufacturing goals and a future forward foundation by providing expertise, auxiliary tools for predictive and preventative maintenance information, and overall process reliability through simulation tools and digital twins.

THE PURSUIT OF A DIGITAL KATA IN INDIANA

The promise of a wholly connected and autonomous enterprise, implementation of additive manufacturing or 3D printing with advanced materials beyond prototypes, wide scale sensing applications for every possible variable, and fully automated core processes exists only in theory. In the current and near future state, there are simply too many barriers to wide scale deployment beyond

pilot and experimental manufacturing cells. Answers to cyber security concerns, readiness of a connected ecosystem of stakeholders, costs, and near term labor dynamics represent these barriers in part.

There are many activities underway in Indiana to advance manufacturing beyond what is possible and what is deployed. These activities have been launched through state of the art pilot facilities like the Advanced Manufacturing Center of Excellence in Columbus, R2 Labs Initiatives from Rolls Royce, and Purdue Polytechnic. To support the existing and near term opportunity for advanced manufacturing throughout the state, evolutionary programs for advocacy and skill-up training were announced in 2018 by Conexus Indiana and INFAME from the Indiana Manufacturers Association. In parallel, organizations like Indiana First and The Maker Youth Foundation continue to build long term sustainability for Indiana industry. By actively deploying STEM initiatives through progressive robotics, engineering, programming, and design:build challenges, the technical and creative skills required for Indiana to maintain a competitive manufacturing advantage are being developed at all levels.

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JASON TOSCHLOG

Chief Innovation Officer
Flexware Innovation

Jason Toschlog is the Chief Innovation Officer for Fishers, IN based Flexware Innovation - an industrial services and manufacturing information technology systems integrator. Flexware's primary mission since their beginning in the mid 1990's is providing meaningful outcomes by remaining customer-centric and technology agnostic.



A HANDS-ON ACCOUNT FOR THE STATE OF THE INDUSTRIAL INTERNET OF THINGS.

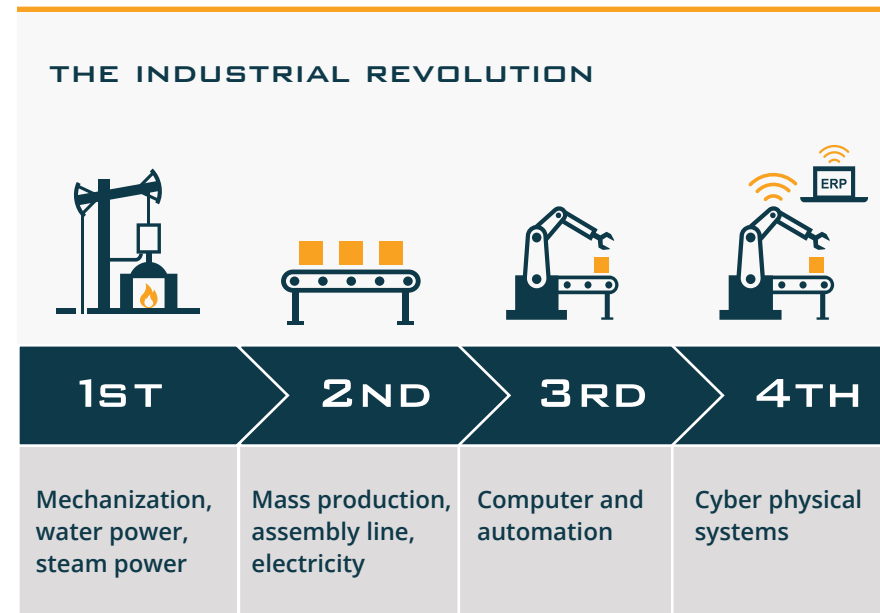
Industry 4.0 and the Industrial Internet of Things are loosely defined terms. Regardless of their definitions, the 4th Industrial Revolution will be defined by a progression toward the following ideals:

	IDEALS	REALIZATION	ENABLEMENTS
01	Pervasive monitoring	→	• Mass customization and consumer demand
02	Integrating entire value chains	→	• Responsive and resilient supply chains
03	Autonomous planning and execution	→	• Both smarter products and services offered and available

Early on in the 3rd Industrial Revolution, factories had islands of automation. As we progressed, the processes within a plant became integrated. Today, most factories represent islands in the supply chain. Piecing together these islands into multi-company supply chains in a way that delivers the ideals above will require better access to near real-time data in a secure manner and structured format providing contextual descriptors. Industry integration standards of the last several decades provide a platform for defining this future, but will need to be combined, extended, and re-imagined.

The actions, plans, and themes in manufacturing today are as varied as the goods being produced in our Indiana factories. Some provide a glimpse to the future while some clearly demonstrate past success being the enemy of that future.

Find out more – www.flexwareinnovation.com





AUTHOR:

CHRIS HARRIS

CEO

WPR Services

Chris Harris is a CEO, entrepreneur, patent holder, and process industry veteran. Following a twenty year electrical and automation engineering career, Chris founded and has continuously enhanced WPR Services over the last two years. The company's primary product is a suite of hardware, including vision and voice-enabled devices, and connected devices that assist customers in addressing, solving, and planning for a variety of challenges in today's manufacturing environment.



ADDRESSING MANUFACTURING OPPORTUNITIES WITH CONNECTED TECHNOLOGIES

POW is not only WPR's PaaS (Platform as a Service) name, it is also the wake-up word for the voice and vision enabled systems, and represents the core technology enabler — Power Over Wiring. In many production plants today, the infrastructure to support digital infrastructures such as ethernet wiring simply does not exist, or provides a costly barrier to pursue connected technology gains. Furthermore, many buildings and dense environments of heavy capital equipment provide inherent challenges for robust wireless connectivity. The POW system addresses these challenges, and provides the opportunity to increase safety, improve maintenance activities, and optimize throughput in a continuous or batch process.

POW is an entry level wedge into the Industrial Internet of Things (IIoT) by utilizing a system of local control links interfaced to existing infrastructure via UHF (Ultra High Frequency) signal transmission and over existing power lines. Through a series of deployed video cameras, electrical monitors and shut-offs, and voice enabled devices, the system provides safe and secure access to the right stakeholders.

Another core challenge in manufacturing is in-plant services are increasingly strained. This is not always about skilled labor, but in many cases, represented by quantity or availability of staff, familiarity with a variety of equipment suppliers, or balancing operational targets with reactive service requirements, often at the expense of actionable and preventative opportunities.

POW was developed from a career of opportunity. These opportunities were historically based on providing services, but increasingly presented to understand the strain in many of today's plants. POW provides secured and monitored remote access to in-plant equipment for the plant staff, the original equipment manufacturer (OEM), and an approved external service provider network. By using local controller logs, electrical monitors, and video history, POW presents MLC's (Most Likely Causes) and analytics that point to potential Root Cause Analysis by comparing current events to a library of previous failures, remedy requirements, and concurrent events. By continuing to monitor, learn, and document, POW leverages data analytics and machine learning to present and optimize FMEA (Failure Mode and Effect Analysis) creation for existing and new systems before the next critical event.

An additional opportunity deployed within POW is voice enablement. As the plant floor, control layer, and enterprise resource planning information technologies become closer linked, the need for a variety of plant associates accessing and reporting meaningful data is increasingly important. Rather than break away from current tasks or recount interface requirements for a variety of task specific software programs, POW integrates voice commands to the required systems and support personnel. Voice is a powerful tool for advanced manufacturing. As data, sensing, and increased events from smarter systems continues to increase, voice enablement creates an immediate productivity gain by minimizing system log-ins, entries, and potential manual errors.

The IIoT is certainly a hot topic. There are a lot of existing opportunities with connected technologies. The key to maximizing the promise or envisioned benefits of connected technologies

requires a basic and fundamental approach. Know the process. Know the people in the process. Recognize the limitations of today's manufacturing environments. Create a plan with goals. For the IIoT to be deployed in a way that is meaningful in today's changing manufacturing sector, the customer's ecosystem must behave as an interdependent system of resources in the same way historical processes and controls were planned to accomplish production outputs.

Find out more – www.wprservices.net

WPR OPPORTUNITIES

04 ●

VOICE

Access to the available information and data when it is needed for who needs it.

03 ●

VISION

Access to machine learning, specialists insights, and library building.

02 ●

CONNECTIVITY

The right people, processes, and machines need to be connected.

01 ●

PROCESS KNOWLEDGE

Successful IIoT Deployments create real, tangible opportunities to address challenges.





AUTHOR:

THOMAS JAMES

Associate Professor of Entrepreneurship
Rose-Hulman

Dr. Thomas James' areas of expertise include new product development, global business ventures, and biomedical systems. He is a Fellow of the American Society of Mechanical Engineers, a registered professional engineer, and an avid inventor who holds over a dozen patents. Prior to joining Rose-Hulman, he worked in the consumer products industry for 13 years as the director of engineering at Milwaukee Electric Tool. Following an acquisition by Techtronic Industries, he became the senior vice president of global engineering for the power tools division, headquartered in Hong Kong, where he lived and worked. In addition to teaching, Dr. James directs the ESCALATE program, a living-learning community focused on integrating entrepreneurship and technical disciplines.

TURNING HARDWARE DRIVEN STARTUPS INTO MANUFACTURING ENTERPRISES THROUGH EDUCATION

There is an interesting duality of talent in Indiana. On one hand, the entrepreneurial community and their financial supporters are primarily focused on software platform development, which is fortified by some recent and very successful exits. The epicenter of this entrepreneurial activity is Indianapolis. Meanwhile, the hardware community has enjoyed steady growth and success in a more rural environment, with manufacturing enterprises accounting for over a quarter of State GDP and over 500,000 jobs across a diversity of sectors, including medical devices, the defense industry, and automotive. Can we get the software and hardware folks in the same boat, rowing in the same direction?

When I attend an investor event in Indianapolis, there is inevitably a

slide that shows a plethora of new brands related to software-focused startups. Alternatively, when I attend an economic advisory meeting, there is a slide that shows the old stalwarts of our Indiana economy, i.e. Eli Lilly, Zimmer Biomet, Cummins, Rolls-Royce, etc. Where are the manufacturing startups?

This may be the precise time for the software and hardware teams to join forces, crossing our geographical and entrepreneurial boundaries from rural Indiana to urban Indianapolis in a strategic effort to lead Industry 4.0 with software-enabled-hardware. The genesis of ideas may well come from our 50+ co-working spaces throughout the state, which can feed our new incubators, accelerators, and labs, like the new IoT Lab in Fishers.

But hardware, as they say, is hard. We need to recognize the differences and difficulties of funding and starting hardware companies if we plan to lead the transition from managed machines to thinking machines. To think, machines need data. Simply put, mechanical sensors that mimic our five senses and software that mimics our brains, all delivered at 5G. Will startups graduating from incubators, accelerators, and labs be in a position to start these new companies? Maybe, but there still exists a valley-of-death between producing a prototype and mass production of a regulatory approved product with customer demand. To cross this valley, it will likely take additional facilities, funding, and experiential education.

At Rose-Hulman, we are prospecting the idea of a Manufacturing Studio to address the facilities and educational gap, and reduce the funding hurdle. The studio concept follows the shared resources model of co-working spaces, accelerators, labs, etc. Not every manufacturing startup needs to hire a manager of manufacturing operations, lease

a space, and buy a forklift. We can establish a space where these resources can be shared across many software-enabled-hardware startups to keep operating costs low while founders learn to capture customers, develop a supply chain, manage the regulatory approval process, and design/build their first assembly line. By tapping into our great educational institutions from around the state, we can provide founders with faculty support, interns, and co-ops to fulfill the multidisciplinary needs of a manufacturing enterprise.

A large-scale manufacturing studio could attract capital and founders from outside of Indiana, as they try to de-risk a hardware startup. After a 2-3 year residency in the studio, founders should have sufficient revenue to support their overhead as a standalone enterprise, taking with them a few well-trained co-ops and interns and an established supply chain.

Find out more – www.valleyhop.org or email Prof. Thomas James at james3@rose-hulman.edu

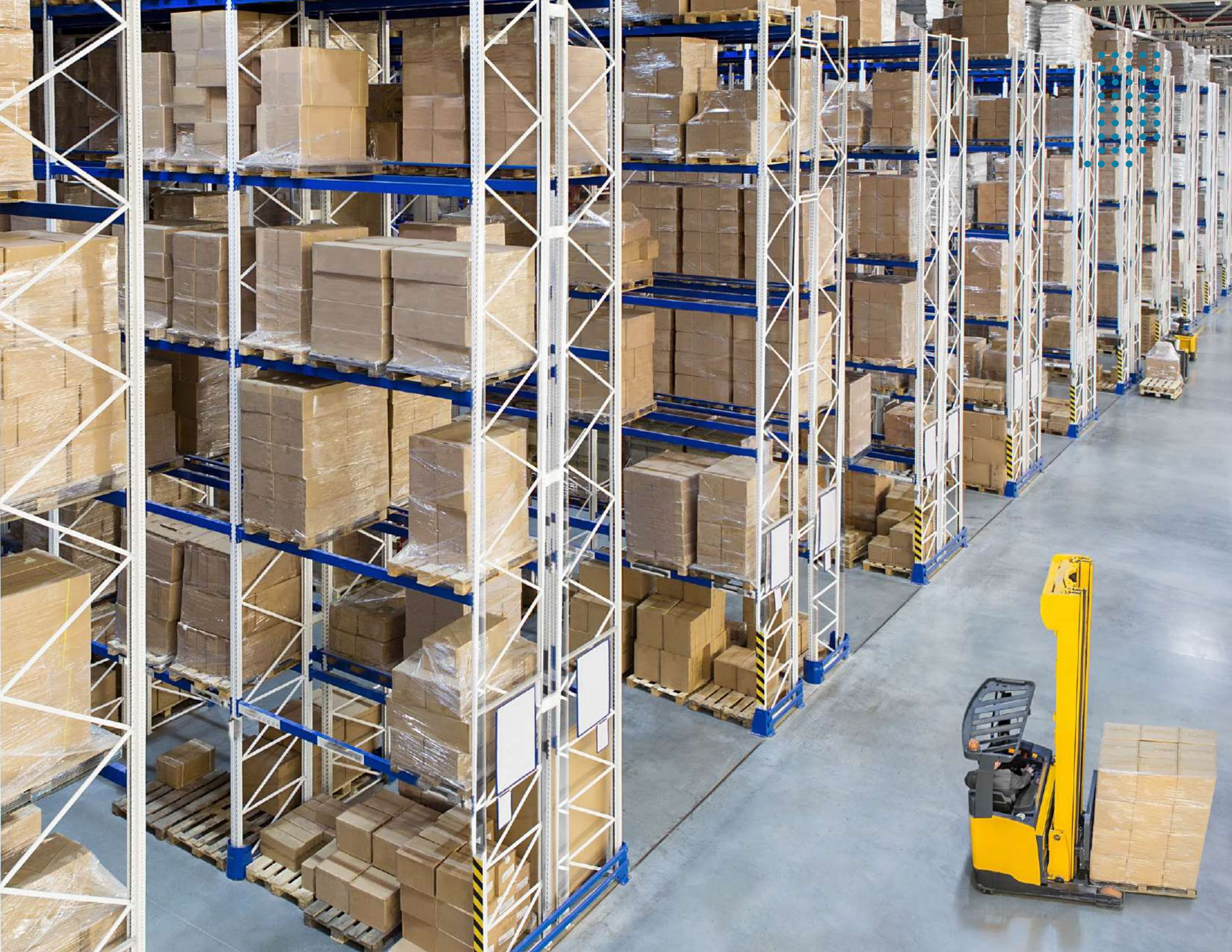


MOVE THINGS

LOGISTICS

Known as the “Crossroads of America,” Indiana ranks in the top 10 among 46 significant logistics-related categories nationwide. Ranked number one in the country for pass-through highways and home to the second largest FedEx hub, Indiana is in a prime position to fill a void in the industry.







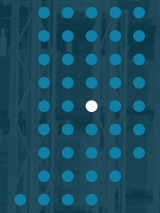
AUTHOR:

J. MARK HOWELL

CEO

Conexus Indiana

Conexus Indiana, founded in 2007 as part of the Central Indiana Corporate Partnership (CICP), is the voice and growth generator for Indiana’s leading industries – advanced manufacturing and logistics.



INDIANA MOVES THINGS

Conexus Indiana accelerates, promotes, and grows Indiana’s world-class Advanced Manufacturing and Logistics economies. Its network of statewide industry, academic, and public-sector partners work together to identify opportunities to develop talent to succeed in an evolving advanced manufacturing and logistics economy and to ensure Indiana leads the nation in technology adoption and industry innovation.

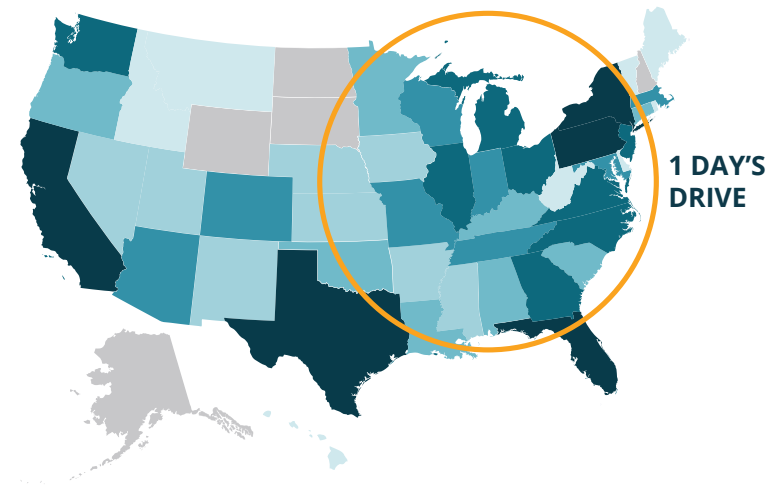
INDIANA’S LOGISTICS NARRATIVE

In 2018, there were nearly 130,000 logistics jobs in Indiana across the full supply chain spectrum. Opportunities exist with global companies

MANUFACTURING INTENSITY



such as FedEx, UPS, and DHL that operate major hubs in Indiana, to nation-wide trucking firms such as Celadon, Venture Logistics, and Atlas Van Lines. As the “Crossroads of America,” Indiana has a natural geographic advantage with a strong network of roads, rail, air and waterways that facilitate the transportation of goods across the nation and around the world. At the same time, technologies and innovations are impacting the transportation of goods through the development of self-driving vehicles and alternative transportation modes such as the Hyperloop. New technologies also are streamlining warehousing as can be seen in innovative automation firms such Bastian Solutions in Carmel and local start-ups including the 2009 launch of Spot to the 2018 TechPoint Mira Award Best New Tech Start-up winner, Indianapolis-based Freight Rover.



WHY INDIANA?

Indiana is a global logistics leader. The state offers companies an unmatched competitive advantage when it comes to reaching North

“**Indiana is a global logistics leader and offers companies a strong competitive advantage when it comes to reaching North American and world markets. Known as the “Crossroads of America,” Indiana ranks in the top 10 among 46 significant logistics-related categories across the country.”**

American and world markets. Indiana ranks in the top 10 among 46 significant logistics-related categories across the country. Indiana is a national leader in pass-through interstates and truck tonnage, experiencing more interstate commerce than any other state. Indiana is home to the 2nd largest FedEx air hub worldwide and is 3rd in total freight railroads. With 3 maritime ports that together rank 6th in domestic waterborne shipping, Indiana provides the only statewide port system with direct waterway access to 2 U.S. coasts. These assets support any logistics-related enterprise and encourage companies to expand or locate their operations in Indiana.

EMERGING TECHNOLOGY TRENDS IN LOGISTICS

In addition to start-ups and innovators shaping Indiana's logistics future, large companies are adopting technologies to remain competitive and respond to customer needs. Emerging technologies are growing in use and increasingly shaping the digital future of the industry. Technologies like RFID (Radio Frequency Identification) in warehouse vision systems, GPS Fleet Tracking, and integrating billing and receiving through ERP systems are now commonplace in linking a company's complex endeavors.

With the growing adoption of IoT (Internet of Things) in the logistics sector, breakthrough innovations from near real-time advancements through Cloud connectivity, planning via simulation of events, and collective end-to-end visibility represent an on-going, large infusion of traditional Information Technology and modernization trends that will drive companies to succeed. Beyond this current industry-wide scale of technology represents the next wave: Blockchain technologies delivering FinTech capabilities to advance fraud prevention, connected containers tracking vital information for quality, climate, and manipulation, and machine learning tools that can minimize transaction complexities and predict consumer expectations.



MAINTAINING A COMPETITIVE ADVANTAGE BEYOND INFRASTRUCTURE

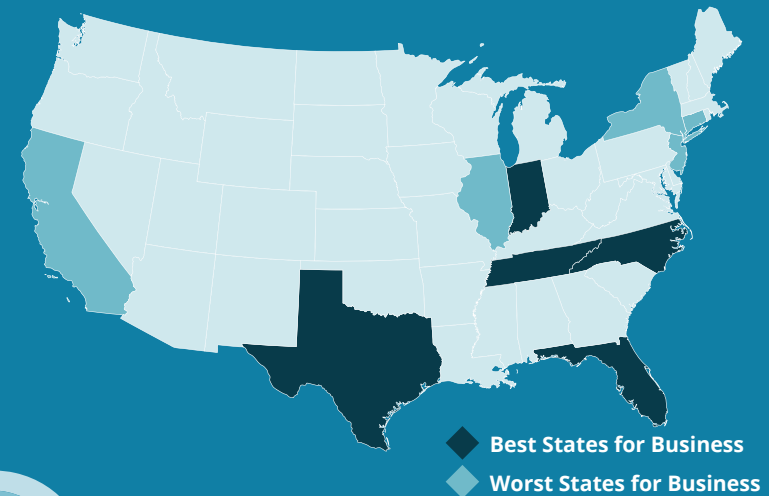
As Indiana maintains and grows its logistics leadership position, Conexus Indiana continues to expand its programming and platform to facilitate, champion, and convene initiatives in workforce and business development to support one of the state's largest industry sectors.

The Conexus Indiana Logistics Council (CILC) is playing a major role in providing a network that fosters greater collaboration among logistics companies in Indiana and deepening the talent pool for the supply chain and logistics industry. The majority of today's industry professionals do not have university degrees in supply chain management or operations – in fact, these degree offerings were nonexistent until 15 years ago. However, as globalization shrinks the world and lengthens supply chains, the demand for highly skilled logistics professionals has never been higher. As a result, Conexus Indiana has sponsored on-campus events to connect post-secondary students directly with industry professionals. By engaging students to explore degrees and careers in supply chain and logistics, Conexus Indiana is ensuring that the industry challenges of tomorrow can be met.

Find out more – www.conexusindiana.com

RANKED BEST IN THE MIDWEST FOR BUSINESS

There are many reasons Indiana continues to lead the nation in job growth and has rightfully earned the distinction of being a “State that Works.” National polls and research organizations have recognized Indiana for its favorable tax environment, low cost of living, leading infrastructure network and business-friendly regulatory framework.



1ST

... in the Midwest and 5th in the Nation for Business
(Chief Executive Magazine)

... Nationally for Cost of Doing Business & Infrastructure
(CNBC)

... in the Midwest and 8th in the Nation for Lowest Taxes
(Tax Foundation)

... in the Nation for Small Business
(The Pacific Research Institute)

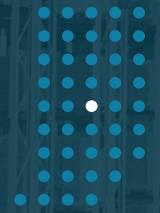


AUTHOR:

DAVID ECKEL

Managing Partner
enVista

David Eckel is the Managing Partner of enVista's Technology Solutions business unit. With more than 20 years of experience delivering technology solutions, David has helped many organizations in the architecture and engineering, e-commerce, healthcare, manufacturing, non-profit and retail industries.



SUPPLY CHAIN'S NEXT STEPS NECESSITATE IOT ADOPTION

Indiana is the "Crossroads of America." Freight, whether moving by truck, rail or plane, plays a significant role in the United States economy in general – but also specifically in the local economy. Indiana's Department of Transportation (INDOT) estimates more than 724 million tons of freight is transported through Indiana, increasing significantly by the year 2040. Additionally, FedEx has committed an additional \$1.5 billion investment to expand capacity and add jobs. Currently, FedEx can process more than 99,000 packages every hour.

The movement of these goods takes considerable coordination between multiple parties to ensure the on-time and safe delivery of the goods to our door steps. To achieve this, organizations within the supply chain industry have begun to realize the benefits of the data

and invest in new ways to collect information through the Industrial Internet of Things (IIOT). The end goal for companies is to make their IIOT data actionable.

PREDICTING EQUIPMENT FAILURES

Union Pacific Railroad is using the IIOT to monitor the condition of its equipment. The company's system can predict equipment failures thanks to acoustic and visual sensors on the tracks. Each day, nearly 20 million temperature readings are processed via data analytics. Several cars per day are now pulled from operation for maintenance in order to prevent derailments that can result in costly delays and hugely expensive cleanup efforts.

PROTECTING THE COLD CHAIN

The IIOT allows for continuous, real-time assessments into the safety and quality of food and pharma products as it relates to their temperature during transportation. AI can use predictive algorithms to identify heightened risks during transport. This helps companies take prescriptive action such as planning and accommodating for hazards during transportation as they arise.

BLOCKCHAIN AND IIOT

The IIOT and blockchain are working together to simplify the fish supply chain from ocean to table and making it easier to track. IIOT sensors are affixed to harvested fish to gauge shipping location, transport temperature, movement and humidity. Thanks to blockchain technology, anyone along the supply chain can track the fish. The final buyer can access a complete record of information and trust it is complete and accurate.

ASSET AND ASSOCIATE TRACKING

In distribution centers, Wi-Fi sensors are placed on pallets, cartons, forklifts, mobile scanning devices, and associates and integrated with inventory and warehouse management systems. This allows for visibility to item locations and a free-flow of real-time data that allows for fast picking and order fulfillment – leading to increased customer satisfaction.

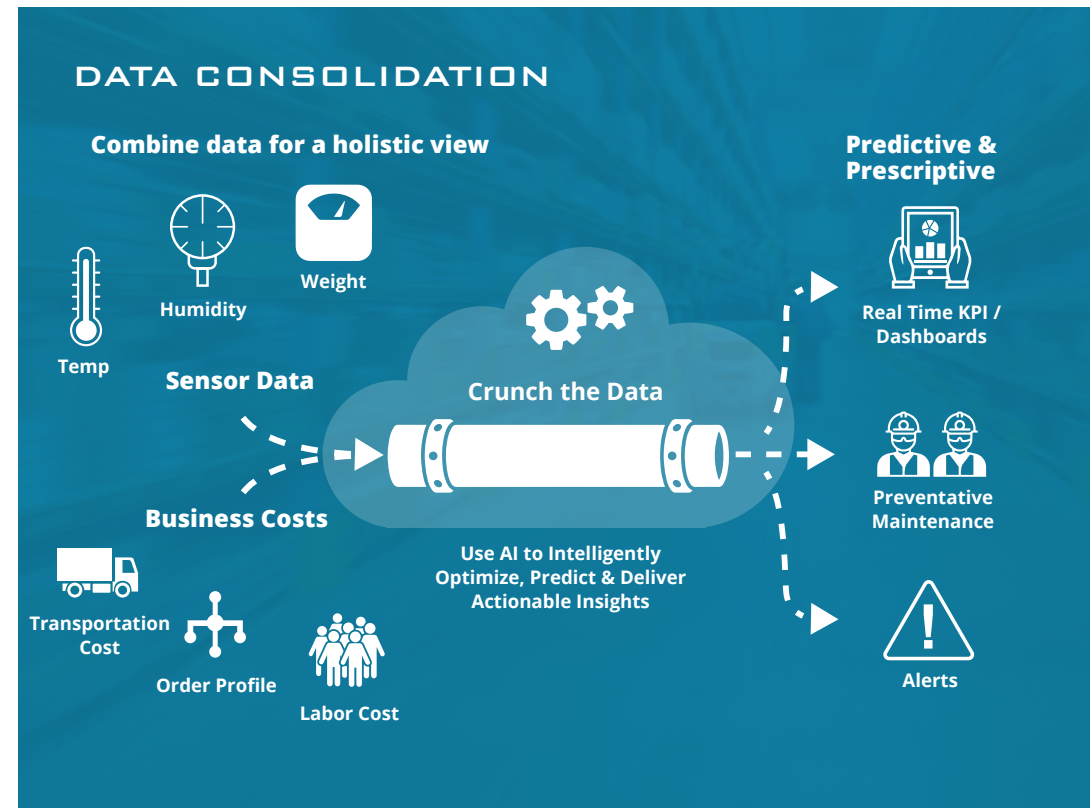
SMART SHOPPING

One way the IIOT is impacting the final steps of the supply chain is through creating new experiences for the consumer. One of these that has been put into use recently is smart beacons. Beacons in retail spaces can connect wirelessly to mobile devices to detect shoppers and recognize them based on past activity or integration with mobile

applications. This helps retailers send targeted advertisements or coupons, and also gives them data which might help in how to layout inventory in a way that leads to sales conversions.

As you can see, the Industrial Internet of Things offers nearly limitless application in both the supply chain and our everyday life. The goal of supply chain leaders should be to use their data, with the help of the Industrial Internet of Things, in a way that helps them make proactive decisions rather than reactive. enVista is committed to helping organizations accomplish that goal. Right now, only 1-3% of devices are IIOT-connected, and the supply chain industry is already accomplishing some incredible things like those mentioned above. It is exciting to imagine what the supply chain, and world as a whole, will look like in the future as we become more interconnected.

Find out more – www.envistacorp.com



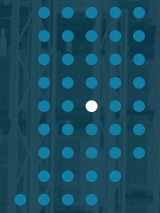


AUTHOR:

LAUREN HOWARD

Vice President – Client Success & Marketing
FreightRover

Lauren serves as the VP of Client Success and Marketing. She has a diverse background in transportation operations, most notably earning honors as a Commercial Carrier Journal “Innovator of the Year” for her work in transforming a publicly traded company’s customer service team. She has spoken nationally on topics of innovation in transportation, technology integration, and attracting and retaining a Millennial workforce.



SUPPLY CHAIN INNOVATION KEEPS INDIANA MOVING FORWARD

Look around your home or office. 71% of everything you see was hauled by truck.

Indiana plays a major role in the annual \$740 billion trucking industry, living up to its motto as the Crossroads of America. The Hoosier state ranks first nationally for interstate highways, placing it within a day’s drive to 80% of the US and Canada population. Indiana operates 44% above the national average for logistics and transportation jobs, with 10% growth estimated in the next 10 years. Paired with a top 15 tech job growth rank, the state represents the perfect roadway to intersect transportation and technology. Indianapolis-based FreightRover launched in May 2017 to do just that with a software suite designed to streamline supply chain management.



FreightRover addresses three key challenges present within logistics and transportation – manual work inefficiencies, shipping capacity shortages, and capital constraints. The platform delivers automation and connectivity to previously fragmented supply chain processes for shippers, suppliers, carriers, and drivers. The business-to-business software optimizes freight flow, provides digital carrier services, and simplifies supply chain payments. Working independently or in tandem, FreightRover's four technologies include:

- **CarrierHQ**, which offers fleets a mobile marketplace with access to tools like pay management, business formation and insurance offerings;
- **PayEngine** streamlines carrier payment processing and free up working capital across the supply chain;
- **SmartLTL** connecting shippers to less-than-truckload (LTL) carriers, providing quote-to-dispatch capabilities in under 60 seconds; and

- **Freight xChange** automates end-to-end truckload freight management by using a custom-designed digital exchange to help shippers locate carrier capacity.

FreightRover earned top honors as Best New Tech Startup at TechPoint's 2018 Mira Awards and was named a Freight.Tech 100 company by the FreightWaves Research Institute. The company has grown to nearly 40 employees in less than two years and raised more than \$9 million in capital to fund its rapid technology advancement. With a growing list of cross-sector partners integrating within the platform, FreightRover sits primed for additional expansion as leader of the pack for supply chain management innovation.

Find out more – www.freightrover.com



GROW THINGS

AGRICULTURE

The agricultural technology industry is growing at rapid rates with more innovation needed to keep up with growing population demands, consumer trends, and required production efficiencies . Data-driven and cutting edge, today's agriculture industry continues its history of innovative machinery, emerging sciences, and land management practices.







AUTHOR:

BETH BECHDOL

President & CEO
AgriNovus

Beth Bechdol excels at building unconventional alliances, connecting people who may not know they need connecting and telling the exciting and inspiring story of the agbiosciences to everyone she meets. Beth has served in leadership roles at Ice Miller LLP, the Indiana State Department of Agriculture, the U.S. Department of Agriculture, the U.S. Senate Agriculture Committee under Indiana Senator Richard G. Lugar and with Informa Economics. Beth believes in serving your community and giving yourself to worthy causes that will change the world.



LEADING AGBIOSCIENCE GROWTH + EXPANSION

Ag Innovation... AgTech... FoodTech... there are a growing number of phrases to describe 21st century food and agriculture.

Here in Indiana, we say agbioscience. Think about the word as a simple addition equation – Ag + Bio + Science. The agbiosciences is the sector where food, agriculture, science, and technology all converge. Today, the agbiosciences brings together modern, innovative “Ag” – or what most people think of as farming or production agriculture. It also incorporates “Bio” – the life sciences, human health, nutrition. And, it includes “Science (and tech)” - meaning engineering of all kinds, computer science, coding, and so much more.

The sector is bursting with cutting-edge technology, science and research — from genomics and biologics to artificial intelligence, robotics, sensors, and digital imagery. The industry is ever changing

and at an even accelerated pace because of technology advancements and the numerous connection points to other industries.

Indiana is a recognized **leader in production agriculture, life sciences, advanced manufacturing, logistics, and tech**. Tomorrow’s agbioscience innovations will come when ideas, creativity, and ingenuity flow freely across these sectors. Indiana is well-positioned to be the home to unparalleled agbioscience talent and innovation.

AgriNovus is a branded initiative of the Central Indiana Corporate Partnership, and its stakeholders from industry, academe, government, and philanthropy work every day to promote and accelerate the growth of the agbioscience community. We care as much about our vision as we do execution on intentional and meaningful programming.

Our success comes because of a multi-faceted approach to Indiana agbioscience growth + expansion. We...

- Amplify the ag+bio+science story and are the megaphone for the agbioscience community.
- Connect people + organizations by facilitating traditional and unexpected partnerships among Indiana's research institutions, global businesses, government, start-ups, investors, and non-profits.
- Build world class talent by promoting agbioscience career pathways and develop industry-relevant skill sets.
- Activate entrepreneurs and accelerate early- and growth-stage companies.

Indiana's agbioscience sector is comprised of innovative companies and entrepreneurs engaged in research and technology development in the fields of plant science, animal health + nutrition, human food + nutrition, and high-tech agriculture.

It will take advances in the agbiosciences to ensure that we find solutions to some of society's biggest challenges. This sector's innovation will allow us to feed the world, protect the planet and improve lives.

AgriNovus is building an agbioscience community and creating a movement. Indiana is done being modest - we are ready to tell our ag+bio+science story!

Find out more - www.agrinovusindiana.com

INDIANA AGBIOSCIENCES AT A GLANCE



\$16 BILLION

Amount agbiosciences contributes to
Indiana's Economy

The agbiosciences employ more than
75,000 HOOSIERS
at wages **30% above** the state average



Home to three of the
largest seed companies
in the world



Only major agriscience company
completely dedicated to agriculture



Largest family-owned, retail seed
company in the U.S.



3rd largest seed
company in the U.S.

National leader in
agbioscience Research
& Development



In 22 countries and has 14 technology
research centers around the world



Largest swine genetics company in
the U.S.



4th largest animal health
company in the world



AUTHOR:

BRAD FRUTH

Information Systems Manager
Beck's Hybrids

As Information Systems Manager at Beck's Hybrids, Brad Fruth works vigorously to deliver value to the American farmer. For more than 14 years, Brad has dedicated his days (and nights) to delivering the successful convergence of IT, data, and precision agriculture. Brad is actively engaged in initiatives throughout the state of Indiana, and sees increased access to rural broadband and focused collaboration across various sectors as bridging the gap between technology and agriculture.



TECHNOLOGY IS EVERYWHERE IN A SEED/GENETIC COMPANY

Agriculture to some is the image of a tractor working in a field or a farmer working hard in his shop. Today's agriculture isn't just implements, iron, and mechanical work. It's a data-driven based industry on the bleeding edge of technology.

At Beck's, we recognize we are quickly becoming more of a technology company every day. Most people would be amazed that the inside of a tractor cab is more technological than most office buildings. Data and technology are used at every step of the growing season, from planning and planting to growing and harvesting, and the analysis that follows. Technology is everywhere. The only way for agriculture companies to continue to provide value to their customers is to embrace it.

When you visit a Beck's facility, you can't go very far without seeing the evidence of this transformation within our own business. Our seed production towers are all IP connected and everything from drives, conveyor belts, cleaners, optic color sorters, cameras, and baggers are all network controlled to allow us to interface digitally into our entire processing operation. The ability for a complete connected plant floor environment provides efficiencies not only on the Information Systems side of our business, but also on the processing side. We can now talk to any piece of machinery in any plant across the nation, monitor and manage it from a central location, and collect data.

Our Practical Farm Research (PFR)[®] program is also blazing a trail in technology as they not only test farming practices like plant

timing, seed spacing, nitrogen usage, and fungicide timing, but also IoT devices like connected weather stations, sub-surface moisture sensors, nitrate sensors, underground drip irrigation, fertigation, bug traps, and UAVs. All this data is used to make better decisions in real time and monitor the crop as it progresses throughout the growing season. We then deliver this research for free to farmers to help them be more efficient and ultimately succeed.

Four years ago, Beck's developed our own SaaS platform called FARMserver®. We recognized the huge need in agriculture to organize the data being collected on the farm. Built from the ground up, our FARMserver platform gives farmers the ability to bring together their planting information, chemical/spray records, UAV data, mobile scouting notes, harvest, and yield information to display on a single pane of glass no matter the color of equipment driving through the

field. Then to top it off, we put a large analytics engine on top so farmers can extract the maximum economic value from the data to benefit their operation. FARMserver was not only built for our customers, but also for Beck's to use internally. The technology we need as a business to succeed is what farmers need as well.

We are very excited about the future of IoT because devices give the ability to sense what is going on below the ground and above the ground. During the biotechnology years, agriculture saw great yield gains. To continue those gains, agriculture companies will now have to fully embrace and champion IoT as an important part of bringing real-time field level data to the grower to make educated decisions quicker. This is the future of agriculture.

Find out more – www.beckhybrids.com





AUTHOR:

LIBBY FRITZ

Director of Communication + Engagement
AgriNovus Indiana



ENTREPRENEURS SEE OPPORTUNITY BETWEEN TECHNOLOGY + AGRICULTURE

Connecting purpose with a mission. Recently I had the opportunity to sit down with two agbioscience entrepreneurs to talk about their journeys, about the importance of making a difference, and how they found a place within the Indiana agbioscience community.

Ellie Symes, co-founder and CEO of The Bee Corp., and Johnny Park, founder of Spensa Technologies and now CEO of the Wabash Heartland Innovation Network (WHIN) are at different stages in their entrepreneurial journey. However, both have found themselves in the spotlight in their own right – for their inventions, their drive to make a difference, and for seeing the potential of converging industries, specifically IoT and agriculture.

Ellie and The Bee Corp. team are rising stars and receiving recognition in the agbiosciences and technology communities. The Bee Corp is a fast-growing start-up that assists beekeepers through IoT and data analytics. Ellie is a graduate of the Indiana University School of Public and Environment Affairs (SPEA).

Johnny was the founder and CEO of Spensa Technologies, which was acquired by DTN in early 2018, and now leads WHIN. Spensa was named by Forbes as one of the Top 25 Most Innovative AgTech Startups in 2017. Johnny was a faculty member in the School of Electrical and Computer Engineering at Purdue University where he also received his bachelor's, master's and doctorate degrees.

THE ENTREPRENEURS



ELLIE SYMES
Co-Founder & CEO
The Bee Corp.



JOHNNY PARK
Founder
Spensa Technologies

During our conversation, the overall prevailing theme is that they care. Both are smart, driven and articulate when it comes to what they want to accomplish. Both are individuals who created their own path in order to combine a purpose with a mission.

Did you always know that you would become an entrepreneur?

- JP** Johnny Park (JP): No. When I was a faculty member at Purdue I did know being a professor wasn't something I wanted to do long term. Starting a company was one of the options I contemplated.
- ES** Ellie Symes (EL): No, definitely not. (laughter) I didn't even realize the things we had done by starting the Bee Club were entrepreneurial at all. This was a complete surprise to me.

What were you doing before you became an entrepreneur?

- JP** I was research professor at Purdue in electrical and computer engineering doing research in robotics, machine learning, and distributive sensor networks.
- ES** I was a student at Indiana University in my first year of my graduate program. I was studying international development, doing a research project with professors from three different universities, preparing to go to India on an international development project, and applying for positions at the U.S. Department of Agriculture Foreign Ag Services. I was on a completely different career path.

How did you have your "aha" moment?

- ES** Let me say, I've learned this is much more of a process over one event. There have been several "aha" moments. Attending the meeting with the IU Foundation Board to present the student Bee Club and being told they believed in me and wanted me to continue to strive for more, that was a pivotal change and shift in me. But I can recognize that is not a normal story.
- JP** I got a USDA grant in 2008 and through that project I got to work with some of the best agriculture sciences professors in the U.S., and I saw the opportunity to apply sensor technologies and robotics to agriculture. This is an industry that meets the most foundational needs to humanity, and what better industry to put your efforts into than agriculture? I fell in love with the people in the industry, and then I knew I wanted to devote my career to this cause and it was something I wanted to do.

What did you do next?

- ES** Two weeks after the meeting and conversation at the IU Foundation Board meeting, we had a meeting where we brainstormed how we could dream bigger. We were guided by the idea of what we could do with technology and sensors to improve beehives. The first step was what type of organization did we want to be. A friend and an attorney in the room asked us if we wanted to be a benefit corporation and that felt like the perfect middle ground with our values and our goals.
- JP** I continued work on the research project and I knew I wanted to commercialize the technology we were developing. I went home

and Google searched “how to start a company”. Turns out it’s pretty easy. I had to incorporate a company through Indiana, which was inexpensive so that’s what I did.

Now that you have gone through the “what you did next,” what would you do differently?

- JP** I didn’t know what I didn’t know! (laughter) But that is the beautiful thing about entrepreneurship and you go for it! You might get knocked down, but you get up and go for it again. Every learning experience is valuable, so I would do it all over again.
- ES** If I could do it again, I would do the customer discovery research we actually did this year up front. We would have come to a different conclusion, and it would have been difficult, but it would have been beneficial to us as a start-up. That was a big lesson for us, and I wish would have done that step first.

How do you incorporate IoT technology into what you are doing?

- JP** Our flagship product was called Z-Trapped, which is an IoT device you can deploy into a field to atomically monitor insect population in the field, uploading the data in real time so the growers and consultants can better manage insects in the field.
- ES** Sensors have always been part of our model, and the vision was to collect more data on beehives for customers and beekeepers and use that data to solve problems. The first product we produced was a temperature sensor for the Queen Bee. In our newest product, we still use sensors but now have them connected to iPhones to view beehive health with infrared heat sensors.

What have you found the most surprising about your entrepreneurial journey?

- ES** I think one thing for us is the importance of a business model and how it can be leveraged to do good things for you. Our business model has shifted but has always kept to our values of providing good.
- JP** As a first-time entrepreneur I really thought in a couple years I could revolutionize the whole world of agriculture, and it took a lot longer than I anticipated. Finding the correct product market fit, message, and the value proposition to the customer are lessons you learn as a first-time entrepreneur, so it took a lot longer to have a product in the market space.

Johnny – you have since sold Spensa Technologies and started on your next path, what do you think about when you reflect on that time in your life?

- JP** All the valuable lessons I learned through that period I would not trade for anything else. And the people – the relationships, the team made the experience great. I look back fondly and treasure the valuable lessons.

Both of you come from outside the agbiosciences but have found your place within the industry – what excites you about the agbiosciences?

- JP** It’s one of those industries that is so basic and fundamental to humanity, yet it was one of the last industries to become digitized with IoT. I see a lot of potential uptake, having a tremendously positive impact on the world. And I get to be part of it.

ES Agree. Pollination is a great place to start because it is part of the entire food production system and yet is something that isn't moving along on the innovation path as fast as the rest of the agbiosciences. A little behind, but a great place to be and fun to be on the cutting-edge.

How do you see Indiana stacking up in its support of agbiosciences/tech start-ups?

ES Indiana is in a great position because we have a lot of global corporations working together to move the sector forward, which is unique. Since they have formed this ecosystem, they are also helping start-ups find the correct pathways within the industry through funding and exit opportunities. It's a really great place for a start-up to be.

JP I agree with Ellie! I will add that it is also beneficial for all of us to have AgriNovus as the conduit for communications between universities, start-ups, and companies to the investors.

What advice would you give to the next entrepreneur?

ES Do 30 customer interviews with end-users, and don't do anything else until you do that! (laughter) You have to do the customer discovery process first. Get ahead by learning from us!

JP Don't wait until you have a perfect plan because that will never happen. Just go with you have! Be persistent, be bold, be humble, and go for it!

Find out more – www.thebeecorp.com and
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CONVERGENCE OF TECHNOLOGY

When technology meets new industries, innovation takes off. The convergence of technology increasingly blurs the lines between our work and day-to-day life through existing capabilities and the future opportunities we have come to expect in the connected world around us.





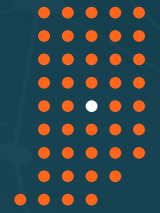


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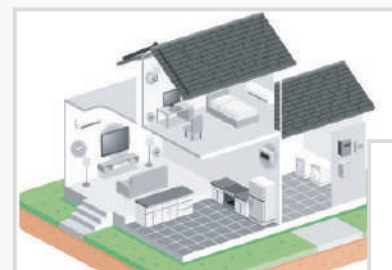
BUILDING SMARTER AND SAFER HOMES

The smart home market, its challenges and opportunities, and a look into the future.

It is important to first define the “smart home.” As in most cases, how you define it drives how you view it. A “smart home” is intuitive, aware, reactive, empathetic, seamless, and adaptable. It’s a big promise offering convenience, the ability to eliminate mundane tasks, and anticipation of the family’s needs. While the smart home has not yet been delivered, it is closer and headed in the right direction, encouraged by the mainstream attention companies like Amazon, Google, and Apple have brought to a mass market hungry for innovation.

We are now in the second phase of the IoT home evolution, having moved from an automated home to a connected home. Initially, home automation was primarily envisioned by early adopter tech

2ND PHASE OF THE IOT HOME EVOLUTION



Automated Home

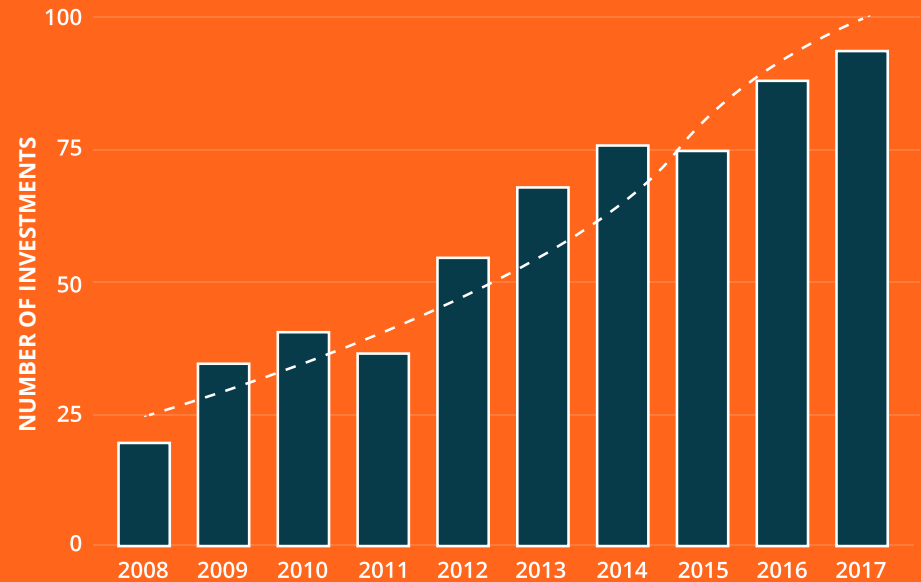


Connected Home

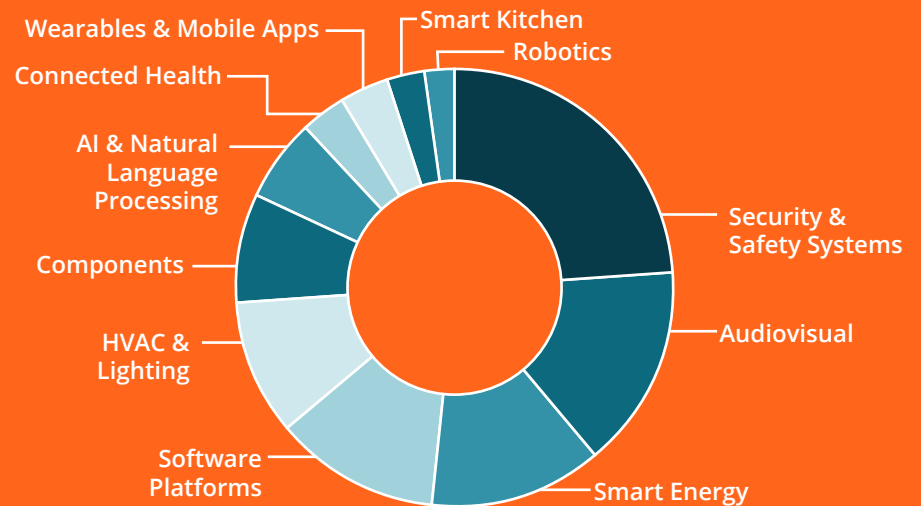
fanatics who cobbled their own system together using products and proprietary user interfaces (touch screens, wall-mounted master controls or tablets and smart phones) to bring it together. Often hardwired, sometimes wireless, the automated home was always complicated, driven with push buttons to “set the scene,” and outdated the day it was installed. The automated home was composed of several single-use smart devices, including IoT-enabled thermostats, garage door openers, and locks which primarily functioned on their own through an app. As home automation devices have gained popularity, attention has turned to creating a connected home, aided by user-friendly interfaces, voice assistants and mobile applications, with more affordable and intuitive single-use products.

The residential Internet of Things (IoT) industry is certainly making progress but not yet delivering on the full promise of the IoT. However, venture investment, consumer acceptance, and commitment from both existing manufacturers and new entrants, point to fully realized smart homes in the near future. Investments into the smart home market –the lifeblood of innovation – are at record highs. As the chart in the top right indicates, the number of venture investments in global smart home technology has grown at an exponential rate over the past decade. In 2017 alone, there were almost 100 deals in this tech category. As you see in the bottom right chart, security and safety has become the largest category for investing. This investment is driving more innovation and resulting in smarter products. Homeowner acceptance, expectations, and desires for a smart home are rapidly growing globally. In our category, Schlage was an early leader in global security solutions for the IoT with products like Schlage Connect, Schlage Sense, and Schlage Control, while other Allegion brands, acquisitions (AXA and Milre), and investments (Yonomi, Nuki and Conneqtech) have further expanded its international footprint.

NUMBER OF INVESTMENTS IN SMART HOME TECHNOLOGIES (2008-2017)



SMART HOME INVESTMENT CATEGORIES, 2017



Source: “Mapping the Smart-Home Market”; By Sonny Ali and Zia Yusuf, published October 1, 2018

This appetite creates demand, which creates change and new opportunities:

- Incumbent brands are innovating and iterating, now entering the second, third, and fourth generation of their hardware and software solutions. Increasingly later-generation products are incorporating newer and better technology at the edge (radios and processors) which makes devices faster, smarter, and easier to use, and provides a better all-around experience.
- Startups are showcasing innovative and unique approaches, and their “art of the possible” inspires even more innovation from their peers.
- Mega-tech entrants, like Amazon and Google, are bringing new ideas, challenging the status quo and creating approachable home control via voice assistants.
- Cloud-based computing and well-defined APIs are helping companies work collaboratively, better, faster, and more purposefully; these alliances are easing barriers to integration, which will allow single-use smart products to create the smart home.
- In the new construction market, home builders are realizing smart homes and media exposure provide differentiated marketing value, and those who cater to homeowner demand are realizing increased sales and margins.

Getting to the last mile of a truly smart home is within reach, poised for widespread adoption and integration. Momentum is in the favor of smart homes, provided the IoT industry can deliver and solve for these six factors:

1. Value creation. The “cool factor” was fine when it was a single-use device on its own, but homeowners want use cases to drive real value when it comes to a smart home. They want their home to be intuitive (it knows it is me); aware (it knows I am in the kitchen); reactive (it knows it’s dinner time and asks if I want to turn the oven on); empathetic (it knows I like to listen to my meditation app to relax when I get home); seamless (security system is disarmed when I walk up, the door locks behind me, lights turn on, and the temperature goes to 70 degrees); and adaptable (the home knew I was out of eggs, has permission to order them from the grocery store and deliver into my fridge, and notified me that my home was secured afterward). That’s a smart home. That’s a smart home delivering value to a homeowner. The question is how quickly ecosystems can come together to deliver on this potential value.

2. Connected versus smart devices. In reality unlike the smart home described above most of the “smart” devices on the market are just connected. Step 1 in making the smart home a reality is creating truly smart devices. The current default design focuses more on how devices are controlled via an app, rather than how they work within ecosystems, and are controlled by third-party interfaces. As more computing power gets introduced to the devices themselves (also known as “the edge”) and combined with the power of the cloud, the result will be true smart devices. This will work itself out as innovation continues. It is a case of when, not if. It is just going to take time and effort.

3. Trust and security. Consumers are weary of cyber-security attacks, hacking, and mismanagement of data; they demand

smart home solutions be both secure and convenient. As the industry matures, the bar will be raised: First, by an increasing number of reputable brands and solutions that deliver consistently; second, by legislation and codes to govern responsible application of technology; and third, by homeowners who are more educated on how the products they bring into their homes protect them and their privacy (and how they can protect themselves).

4. Inconsistent experiences. Consumer expectations are high, and they should be. Unless products work together and create use cases that homeowners rely on for daily living, the long-term adoption rate will be artificially limited. The good news is manufacturers recognize this, are working closely together and, when inconsistencies happen, are proactively and sometimes predicatively notifying, addressing, and fixing them. This part, frankly, is hard and will not be 100-percent avoidable. But we can design products with best practices, test them to find bugs in the lab versus in the field, have processes in place to address problems, and implement many more approaches reducing the likelihood of negative consumer experiences.

5. Lack of standards, legacy technologies and purpose-built products. The desired utopia is one where the smart home has a standard operating system all devices work with and use to communicate. Unfortunately, it is not going to happen. What will happen is segmentation and narrowing of the many different protocols driven by mega-techs and the technology delivering the use case (e.g., Amazon, Google, etc.) and go-to-market strategies supporting the business case (e.g., Comcast, Alarm.com, etc.). In the end, the prevailing protocols are Wi-Fi,

Bluetooth, Zigbee, and Z-wave. There will be others, but for the foreseeable future (which is dictated by the past primarily), this is what we have.

6. Price. As outlined in research by McKinsey & Company (“There’s No Place Like Home”), in order to gain widespread adoption, devices and the systems that bring them together need to be more affordable and extend beyond just the hardware and software costs to include third-party installation and configuration. The underlying system needs to be affordable. That said, manufacturers and service providers that go beyond the cool factor are finding new revenue streams from value-added services. For example, new business models are being introduced where hardware costs are offset by monthly service fees (in some cases, manufacturers are going direct to homeowners who see value in the data), as well as models with a monthly fee subsidizing all of the hardware (manufacturers are becoming service providers to homeowners).

So, when will the smart home become a reality? With the speed of innovation, investment dollars pouring in, businesses finally seeing the smart home as differentiation and a land-grab opportunity, and a consumer more ready and willing than ever, the future of a true smart home is not too far away. What we have today (0-12 months) is a connected home. What we will have tomorrow (12-24 months) will be smart devices. And what we have in the future (24-36 months) will be the smart home. As they say, “The past cannot be changed. The future is yet in your power.”

Find out more – www.allegion.com



AUTHOR:

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President

Ultimate Technologies Group

Will O'Brien is an entrepreneur, business leader and former Fortune 500 company executive. He founded and currently lead Ultimate Technologies Group, a tech company dedicated to designing and installing commercial audio-visual, IT solutions, building controls, and technology integration.



COMMERCIAL BUILDING AUTOMATION MARKET CONDITION

The commercial building automation market is growing at a significant rate as companies and governments all over the world have shifted their focus on constructing green, energy-efficient buildings.

Initiatives such as mergers and acquisitions, improved products, and the penetration of new markets has played a crucial role in the development of the commercial building automation market, which is highly fragmented due to the presence of a large number of regional players.

The commercial building automation market was valued at US\$77.63 billion in 2016, and is anticipated to reach at US\$108.49 billion by the end of 2024 globally. The market is expected to grow at a CAGR of 4.3% steadily during the forecast period. According to product segment, the global commercial building automation market is

bifurcated into HVAC control, light control, security & surveillance, and room automation (mostly audio-visual).

Europe and North America are anticipated to hold the majority market share throughout the forecast period. Energy-efficiency and cost-effectiveness is one of the main driving factors for the growth of commercial building automation market in these regions.

The global commercial building automation market is expanding and is expected to see lucrative growth due to the continuous developments in construction sector. With rising economic growth, demand for construction projects has increased across the globe. Rapid development in the construction sector has also led to reduced volumes of materials coupled with less use of power. Adding to this,

governments have imposed various strict guidelines over the effective utilization of resources as environmental pollution increases. This is estimated to positively impact commercial building automation development in the coming years.

There are some challenges faced by commercial building automation system. The cost involved in maintaining, operating, and installing these systems is higher. Due to these high costs, the new entrants are finding it difficult to penetrate the market. Also, the low rate of return is impeding the adoption of commercial building automation to the end-users. In the coming years, this factor is predicted to create issues for small players in commercial building automation market globally.

MANAGING GROWTH

Ultimate Technologies Group (UTG) was founded by Will O'Brien out of Launch Fishers in May of 2017, as a home automation company. According to O'Brien, "The Launch provided us with the right culture, environment and network to successfully launch the company. The team started with 4 people, and they built initial processes to get the first large customer, Toyota, by the end of 2017. This was a clue to the team that commercial automation, audio-visual and information technology was a better fit for them rather than residential. 2018 began the meteoric growth of UTG focused on these three areas. They hired more and more people, while having no turnover since the company's inception.

Half way through the year, UTG began talks to acquire Electronic Evolutions, another Indianapolis-based commercial supplier of high-end audio-visual products and services. This positioned UTG as a

major player in the Indianapolis area and beyond. As of the end of 2018, its first full operating year, UTG was on track to hire its 37th employee and deliver over \$5MM in sales, now bragging customers like One America, Cummins, FBI, Amazon, and the likes. UTG contacted Fishers' Mayor Scott Fadness and the Indiana IoT Lab about its space issues, and within a week had worked out an arrangement to locate its operations and customer service functions out of the IoT lab.

UTG starts 2019 with a strong pipeline, a very talented team, and a track record of success.

Find out more – www.ultimatetechnologiesgroup.com

“We will continue to go where the business takes us, servicing customers outside of Indiana and new verticals appear to be on the 2019 horizon for us.”





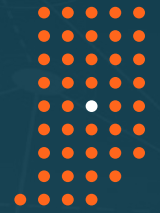
AUTHOR:

BRANDON FISCHER

CEO

Omni Automation

Brandon has 25 years of experience designing and developing interactive software-based solutions for web, mobile, desktop, and large-scale video wall systems. In 2005, Brandon founded the company Anacore... an Indianapolis-based custom software development company, turned product company in 2009. Anacore created two products: MediaStation, an interactive digital signage platform; and Synthesis, a multi-user collaboration platform. Anacore was acquired by Silicon Valley-based, Prysm, in May 2014.



IN PURSUIT OF THE SMARTEST HOME

The smart home is currently a myth. What people refer to as a 'smart home' today should really be called a 'connected home.' The connected home is achievable. If you want to create a connected home, you have two options: (1) You can spend thousands of dollars and hire a home automation company to litter your home with a network of sensors/devices and program an elaborate control panel to control everything; or (2) You can try to do it yourself. You'll spend less money upfront but make up for it in the time you spend trying to get everything to work together, not to mention the 10 different apps on your phone to control everything!

Unfortunately, these apps don't often work together. While there are a few emerging platforms that attempt to bring it together, it's still just a connected home. It's not smart — it's programmed.

Enter Omni Automation. Omni is an Indiana-based startup building a platform to achieve a truly smart home that programs itself. The 'smart' home of the future, enabled by Omni, knows each member of your household - even your pets. It knows who is home at any given time and, when the house is empty, it will ensure everything is turned off and your home is secure. It learns each individuals' habits and routines and adapts as they change. Ultimately, the smart home of the future can anticipate what you want to do before you step foot in the next room.

Omni Automation was founded in early 2018 by Brandon Fischer and Stephe Blansette. Previously, Fischer founded Anacore, an early pioneer of collaboration software for large interactive displays, before it was ultimately acquired by Silicon Valley-based Prysm, Inc. Fischer partnered with Blansette, a residential and commercial home and building automation system integrator, and the two boot-strapped Omni Automation. Combined, the two have over 40 years of IT and home automation experience. It was their shared appreciation for high tech, artificial intelligence and gadgetry that helped them realize there was a gap between the connected home and the smart home of the future.

By the end of 2018, Omni Automation had assembled a team of hardware and software engineers from the Central Indiana tech community. Now with a team surpassing 10 members with complimentary skills, the company will debut its MVP product in a newly constructed model home and living lab environment within the Indiana IoT Lab in Fishers, IN.

Set to launch in early 2019, “The Smartest Home” will showcase Omni Automation’s work to date and provide a test and development lab for further refinement of the Omni platform.

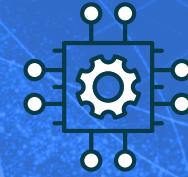
The Omni platform consists of a network of devices that replace light switches throughout your home. Each of the devices is packed with a multi-sensor array that can detect things like motion, ambient light, temperature, humidity, and vibrations (such as foot steps or glass breaking), among others. These devices essentially form a neural network — working together to get to know you, understand you, and ultimately provide convenience, safety, and productivity for you and your family.

“It is with the experience and respect of the connected home and its potential for convenience, safety, and ease of use that a group of experienced developers, integrators, and serial automaters can drive a wedge to provide a truly desired smart platform.”



Omni becomes an automated and friendly medium between you, your family members and pets, as well as your home’s connected products, and the most common smart home automation systems from Amazon, Google, and Apple active in over 25 million U.S. homes today. At its core, the Omni platform makes the cumbersome job of managing multiple home automation apps obsolete. Omni doesn’t denounce the connected home. It helps those trapped in the connected home realize their full potential.

Find out more – www.omni-auto.com



**MACHINE
LEARNING**

THE BUILDING BLOCKS OF IOT

Machine Learning, data, legal, ideation, and security are building blocks of IoT technology. Information analysis guides next moves through insights we gain from data collection. Legal considerations are vital for the success of connected technology to protect privacy, intellectual property, and patents. Ideation fuels development and customer validation while security ensures long-term success and more importantly, trust in the rapidly growing IoT.



DATA



LEGAL/IP



IDEATION



SECURITY





clear
object



AUTHOR:

JOHN MCDONALD

CEO

ClearObject

John McDonald is the CEO of ClearObject, Inc. Magazine's fastest-growing IT company in Indiana for 2014, 2015, 2016 and 2017, and winner of the 2016 Entrepreneur Magazine 360, the 2016 Deloitte Fast 500 in Technology, the 2016 CRN Next-Gen 250 and 2015 and 2016 IBM Beacon Awards, the highest honor given to a business partner.

MACHINES THAT LEARN LIKE HUMANS

When cavemen were learning how to make fire, there were no college courses or textbooks. Instead, they watched other cavemen who knew how to do it, attempted it themselves, only to fail, and then were corrected by the master repeatedly until the skill was learned. Now, as then, observing, trying, failing, correcting, and trying again is the only way humans learn new things. We build a model in our minds through iterative experiences, and then use those models to quickly assess a problem and look for a solution. Over time these repeated experiences hone the model in our brain to greater precision, not unlike a pixelated digital photograph that sharpens to a finer resolution as more data is filled in.

This model of cognitive processing has served humans well over the years. It allows us to size up people and situations quickly and infer great understanding from body language, a raised eyebrow, or even how a word is pronounced. It also harms us, as we can be slow to react to things that fall outside our normal cognitive patterns, such as when a fire breaks out in a club and patrons are slow to move to the

exits, or when gunfire rings out at a public event and our first reaction is to think that it's part of the show we're watching on stage.

Up until recently, however, that's not how we've approached the problems of processing data in computer systems. Nearly the entire history of computing has been focused on automating tasks that were once manual processes. How many are aware the spreadsheets that run so much of the business world today got their name from paper ledger sheets that opened to a two-page "spread" that early accountants would fill out in pencil and ink and recalculate by hand? Since the mid 2000s when "big data" stored in "data warehouses" and the like began, we've slowly been changing our focus from process automation to looking for insights in all of that collected data.

Frustratingly, much of the big spend on collecting and analyzing big data has not resulted in big results. While the technologies for ingesting, storing, indexing and visualizing data have come a long way, it fundamentally still requires human brains to sift through reports

and pictures to locate insights. The tools assist in putting a grappling hook on the quantities of data involved today, but they do not lead to breakthroughs without human involvement. Information technology people still look at the problem as a programmer would, seeking to develop complex if-then-else statements that codify a model into steps, only to find that each fresh batch of new data breaks these rigid constructs.

What if there were a way, however, to empower computers to build models on their own? What if instead of humans building analytics models, the machines did it themselves, similar to how a human learns through observation, trial, failure, correction and trying again until success? What if these models automatically improved with more new data, rather than more new data breaking rigid pre-programmed rules?

The concept of training a computer-created model through iterative data input and correction is called machine learning, and it's the white-hot center of the IoT business today. It's new, more correct terminology for something we used to call "artificial intelligence" – a poor term because it's not really intelligence, but there's nothing artificial about it. It's very real, and very important to harnessing and understanding data coming for a wide range of new devices all over the planet.

MemSQL and O'Reilly media partnered on a survey that surprisingly found 61 percent of organizations most frequently picked machine learning as their company's most significant data initiative for the next year. Deloitte Global notes the number of machine learning pilots and implementations doubled in 2018 over 2017, and will double again by 2020. Google and MIT uncovered that 60 percent of organizations are already at various stages of machine learning adoption, with 45

percent saying the technology has already led to more extensive data analysis and insights.

In his groundbreaking book, *The Singularity is Near: When Humans Transcend Biology*, futurist Ray Kurzweil calculates the exponential growth in cognitive computing power relative to human intelligence. As validated by several other writers, Ray points out that in 2015, all the computing power on the planet roughly equaled the power of the brain of one rodent mouse. As evidence, however, of the acceleration of this cognitive power, he estimates that in 2023, just a few years from now, all the computing power on the planet will roughly equal one human brain. Yet, the most interesting intersection between computing and human power is predicted for 2045, when the power of computing roughly equals all human brains. That moment, somewhat ominously labeled the "singularity", has implications that are nowhere near fully explored, and an impact on humanity that is difficult to underestimate.

Finally, as if there were not already enough economic reasons to move computing resources to the cloud, it's important to note that the power of cognitive computing as delivered through machine learning is only economically feasible as delivered from the cloud. Implementing on premise solutions with that degree of processing power, and with that degree of technical sophistication in software, are unlikely to be funded based on the enormous cost differences compared to global, scaled cloud platforms. This means that any organization that is slow to embrace the cloud will, by translation, slow to benefit from machine learning.

Machine learning is key to finding insights in data, particularly as data sets grow rapidly in the Internet of Things.

Find out more – www.clearobject.com



INDIANA UNIVERSITY



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Sunandan Chakraborty focuses on data science for social good. Building computational models that leverage vast data sets, he applies them to a broad spectrum of problems in social and environmental science, agriculture, health, and other fields. He draws on diverse data sets and uses tools such as big data analytics, machine learning, information extraction, and time series analysis to compile information and discover knowledge that can lead to solutions.

DATA SCIENCE FOR SOCIAL GOOD

There is a wealth of information on the Web from a wide range of disparate sources. These datasets come in various forms -- news articles, social media, organizational reports, images and many others. It can be overwhelming for a user to look for specific information. Our research goal is to have a precise and succinct representation of this large volume of data and convert it into insightful knowledge. This is a challenging problem, as these datasets are mostly unstructured, noisy, sparse, and often contain contradictory or misleading information. Our goal is to design big data analytics methods and algorithms tolerant to noises and efficient in dealing with huge volumes of data, eventually applying these techniques to real-world problems with a social impact.

EVENT ANALYTICS AND PREDICTION FROM NEWS ARTICLES

We developed a novel method of representing news events using the conventional event extraction task parameter – event triggers. The

model is based on the assumption that every news article is about one and only one event, and this event is drawn from a larger event class, modeled by similar event triggers. An event class represents an abstract grouping of similar events, agnostic of spatio-temporal, entity, or topic based features. Whereas, an event represents an instance of an event class with specific spatio-temporal features, along with entities and topics participating in the event. This instance or the occurrence of the event is manifested in a news article. Our model captures the central event (within the headlines or the lead paragraph) as a collection of words/phrases that best describes the main theme of the article, called event triggers. Subsidiary events in an article are events described in the body of the article and related to the central event; similar to the central event, the subsidiary events are also represented by a collection of words. Our event class model can model any events, provided there exists at least one article in the corpus that is about the event.

Events extracted from news can be used to build a succinct representation of large amount of news. Such a representational framework can have numerous applications. We show how these events can be used to characterize and predict fluctuations in socio-economic indicators. Many socio-economic indicators are sensitive to real world events. Proper characterization of events can help to identify a subset of events that drive the fluctuations in these indicators. We have demonstrated how the event model can be used to predicting commodity price fluctuation. Experimental results show that our model demonstrated an improvement of 5-10% over non-event based predictive systems, including an LDA-based predictive model. Experimental results show that our model can predict sudden fluctuations in food price with an accuracy of 62% and stock prices with an average accuracy of around 64%.

DETECTION OF ILLEGAL WILDLIFE TRADE ON THE WEB

Direct exploitation, which includes the trade of wild animals for their parts, is one of the greatest threats to biodiversity. Digital communication tools, particularly the Internet, have further facilitated the global trade in endangered species. Until now, evidence for the online wildlife trade has been compiled by civil society groups that rely on manual searches by teams of volunteers, and the effort has often focused on charismatic species. To tackle this situation we have built a tool to automatically search and detect illegal ads in popular online platforms, including online marketplaces and retail sites. This tool is aimed is also aimed to quantify the sales of potentially endangered and illegal wild animals online across the Web.

We built a statistical learning model that analyzes each ad and its features (i.e. title, price, description) to determine whether the ad is

likely derived from a wild animal or not. For example, wildlife-derived items (tiger skin rug) were classified by this model as distinct from non-wildlife-derived items (tiger pajamas or tiger toys). We formalize this problem within the context of latent variable models, for which variables are categorized as either observed (e.g., title, price) or latent (i.e., whether it is a genuine wildlife product). Latent variables were estimated through the learning process, during which the latent variable is binary (wildlife product or not). This approach uses the title text, price, item location, seller id, item category as observable variables (X) and whether the item is related to a legitimate wildlife product as the unobserved target variable (Y). We also included image based features in this classification model but due to high variability, the predictive power for images was low. After identifying likely wildlife ads, the final step was to map each of these ads to a possible species (or species group) and determine whether the item for sale was derived from an endangered and/or illegal wild animal based on the listings drafted by international organizations, such as, International Union for Conservation of Nature (IUCN) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listings. We also developed a novel string similarity algorithm to identify scientific, market, and common names of these species in the ad text.

SATELLITE IMAGE ANALYTICS

Updated as well as historical satellite images across the world is freely available on the Web. This offers an opportunity to address many problems related to agriculture, disaster management, urban planning from this dataset. We worked on the design of an automated satellite image analytics tool that can leverage publicly available satellite image data sources to provide a fine-grained longitudinal analysis of changes

in land pattern in a given region. Our goal was to design a data analytics system that can understand the longitudinal relationship between the changes in agricultural land pattern in a given small geographic area and its corresponding impact on food production. We used a corpus of satellite images gathered from Google Earth, which maintains an updated repository of satellite images along with an archive of older images across the globe. The key building block of our analytics tool is a satellite image analysis engine that can analyze potentially noisy satellite images and provide fine-grained classification of regions within each image into different categories such as arable land, water body, developed land, forest etc. Given historical data about the same location, the image analysis engine can provide a detailed analysis of land pattern changes.

We developed a similar tool to detect road patterns from satellite images to create automatic maps of regions around the world. In both these tools, the underlying models were based on a modified versions of Convolutional Neural Network (CNN). These models used a preprocessing layer to segment and cluster the images and finally passed through a more traditional forms of convolutional, pooling and fully connected layers to finally emit the predicted output.

In another similar project, we are focusing on a regional assessment of soil degradation and reclassification to the urban soils classification in Marion County, Indiana. We are working with the United States Geological Survey (USGS) and Indiana Water Science Center to build a computational model that automatically identify the changes in the land pattern using historical aerial images. The key component of this tool will be to classify aerial

images into several categories, namely – agricultural, industrial, urban, and waterbodies. Our classification tool will be used to create a land distribution map across Marion and neighboring counties. The purpose of this map and the underlying data will be to discover the latent relationship between how the landscape is developed (i.e. manipulation of topography and pervious soil) and streamflow response. This will help us to better understand how future development can increase disaster risk in the Marion county region. In this project, we will identify the soils and landscape positions being converted to development and determine if there is consistency among drainage areas. Our analysis will include historical stream flow data from USGS stream gage sites, historical and current soil surveys, land use/land change information from Landsat and other satellites, coarse characterizations of soil-water content (SMAP), and topographic analysis (including 30-m, 10-m, 3-m, and 1-m elevation data) available for the last 40 years. Land cover analyses will use a combination of the Landsat Data Continuity Missions (LDCM), the Multi-Resolution Land Characteristics Consortium (MRLC), and anthropogenic land use trends (NWALT; Falcone 2015). Six remote sensing missions using Small Unmanned Aerial Systems (sUAS) will be flown during this study. The focus of our study will be the White River, upstream of the USGS gage in Indianapolis Imagery collected from sUAS will augment these datasets, providing a current snapshot of the stream environment relative to surrounding development.

FAKE NEWS DETECTION FROM SECURE SOCIAL MEDIA PLATFORMS

“Fake news” has been an important part of our contemporary public discourse, the term has been used by a variety of actors to suggest broadcast items that mislead people in the guise of legitimacy. In India, with a large share of new social media users, information that

is either blatantly false or motivated to inflame can spread to a large population within a small span of time. On many platforms, such as WhatsApp, it becomes extremely difficult for law enforcement to intervene and stop such information from spreading due to encryption of messages. At present, most of this detection is carried out manually. With the increasingly fast rate of generation and even faster rate of spread of such stories, it is infeasible to rely purely on manual interventions to address this problem.

However, not all such information is “fake” in the strict sense. Motivated, or deliberately biasing news presents some of the same risks of inflaming passions. In the context of social media, motivated information refers to a messages that offer a biased, explicitly false, or propagandist information with the goal of misleading the reader to some end benefit of the creator of such information, or even for pure mischief. This broader category is harder to target since it deals with human bias, consequently human detection of it requires overcoming inherent biases and making qualitative judgment. We refer to these types of information as ‘motivated information’ in that they may be fake, but also may have elements of veracity, but are phrased with bias for affective outcome. Motivated information detection on social media presents unique challenges that make existing detection algorithms relatively ineffective.

First, such information is intentionally composed to mislead readers to believe false information, which makes it difficult for machines to detect any kind of misinformation based on the content alone. This makes it necessary to include auxiliary information, such as user social engagements on social media, to help make a determination. Second, exploiting this auxiliary information is challenging as users’ social engagements with motivated information produce data that is

big, incomplete, unstructured, and noisy. The lack of updated datasets or a repository of motivated information items makes it hard to apply big data analytics to address this problem. As a result, a number of existing detection systems are based on manual methods. In addition to content analysis of these items, ideally an intervention needs to function at the level of the platforms (i.e. social media tools) to stop further spreading of such items. Hence, there is a need for a tool that will detect suspicious and false information and remove them from further spreading.

We address one of the main issues behind this problem – lack of data on closed or private platforms. We address this by creating a platform to collect and produce data that by itself can create an impetus to further research to detect fake news and reduce its effects. In addition, our focus is to address the gaps in the present data mining techniques that impedes the detection of false information and stop from spreading. To address this issue we build a tool that crowdsources the data collection. This tool is a smartphone app that users can use to share social media contents that are otherwise not directly accessible. In addition, we develop a novel data mining technique to identify motivated claims in shared items. The user shared information from the app is used as a training set to develop a statistical learning model that will evaluate the authenticity of the shared information. This model will use the text and image content of the messages, as well as additional meta-data to train a classifier that will produce an authenticity score that would reflect the scale of false information present in the message.




predictive
partner



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Morgan is an experienced C-Suite executive most recently with a large Midwest consulting firm. Morgan's knowledge of analytics spans teaching at the graduate level, implementation with Salesforce, and solution design for the state of Indiana. Morgan holds a PhD from Caltech and BA from Hope College.

CLOSING THE GAP BETWEEN DATA AND ACTION

With the Internet of Things (IoT), businesses scale more efficiently, realize operational efficiencies, and increase revenue by delivering greater value. However, connecting devices to receive better insight is not enough. The goal of IoT is eliminating the gaps between data, analysis, and action. The promise of IoT is taking cost out of the business and increasing revenue. The value of IoT is realized with a data and analytic strategy to know when, where, and how to use data.

Traditionally, historical data was used to generate static reports that informed future analysis and decisions. Completing the chain of data collection, analysis, and decision making was slow and significant

“**IoT combined with analytics makes business predictable which creates opportunities to reduce cost and increase revenue.**”

time could pass before any action was taken. This gap between information and action resulted in cost inefficiencies and missed sales opportunities.

Today, IoT allows companies to automate decisions and eliminate the gap between data and action. Real-time IoT data is continuously ingested into analytic engines that automatically optimize and coordinate decisions across inventory, logistics, resourcing, and sales.

IoT and analytics make business predictable, which creates opportunities to reduce cost and increase revenue. For example, IoT and analytics allow business to better predict customer purchasing decisions. Armed with better customer insights, sales teams experience fewer missed opportunities. By seamlessly coordinating logistics and inventory decisions, IoT initiatives remove cost from the business.

Ultimately, the value of IoT lies in implementing a strategy that leverages data and analytics. For example, Predictive Partner is reducing client operational costs by leveraging IoT sensor data to predict and optimize the routing of orders not yet placed. At the same time, the sales and marketing departments analyze the sensor data to identify and intervene with customers at risk of churn.

“**Predictive Partner is reducing client operational costs by leveraging IoT sensor data to predict and optimize the routing of orders not yet placed.**”

There are many possibilities for utilizing IoT. The best ones combine IoT and analytics within a strategy focused on delivering quantifiable ROI. Thinking strategically and understanding IoT's role in achieving the goal is paramount. Once IoT's role is understood, it is straightforward to quickly pilot, evaluate ROI, and decide whether to iterate, stop, or expand the pilot.

Find out more – www.predictivepartner.com



PREPARING STUDENTS FOR THE FUTURE

BY JASON KRUEGER | FOUNDER

StratoStar's mission is prepare students for the evolving tech-focused workforce, using IoT to take learning outside school walls and create the next generation of scientists and engineers.

Enabled with IoT technology based on satellite radio, StratoStar's high-altitude balloons can travel hundreds of miles in the jet stream, reaching altitudes over 20 miles above the Earth's surface. Students are able to develop projects and experiments collecting data from anywhere on the planet, sending that data to our cloud-based application which is then displayed on their smart devices for analysis. The social media integration makes their science and engineering projects a social experience as well, allowing students to engage the wider community.

Working in teams utilizing 21st century skills of communication, collaboration, critical thinking and creativity, students are able to get hands-on experience with the latest technologies in M2M and embedded electronics. StratoStar is excited to continue developing educational programs utilizing IoT technologies to see how students will use it to explore and develop solutions to shape our society.

Find out more – www.stratostar.net

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THE INTERNET OF (LEGAL) THINGS: LEGAL CONSIDERATIONS FOR CONNECTED DEVICES

by Judy Okenfuss, Ice Miller LLP

There is no question the Internet of Things (IoT) is changing the way business is done. And sure, you want to be fast to bring things to market – but don't be too fast!

The IoT presents new legal risks and challenges that need to be considered as IoT adoption continues. Businesses need to ensure their internal departments are working together – and yes, that means including legal. For example, there may be underlying issues related to contractual relationships about which your team needs to be aware – do your contracts address the questions of “who owns the data?” or “who is liable should something go wrong?”

Systems and processes must be in place to protect your customers and your business. The following short articles address some specific intellectual property and contracting issues of which to be aware, as well as some security tips for protecting your connected business.

Ice Miller's IoT Industry Group includes attorneys who are engineers, IT analysts and data architects, with legal backgrounds, who are helping clients stay ahead of a changing world. You can view more IoT legal insights and resources at icemiller.com/iot.

INTELLECTUAL PROPERTY LITIGATION AND THE INTERNET OF THINGS

Bryon Wasserman and Tom Walsh, Ice Miller LLP

The Internet of Things (IoT), namely the interconnection of computing devices embedded in physical objects to allow for remote monitoring and control, has moved into the mainstream during the last few years, with broad applications in everything from agriculture to personal fitness. The combination of cheaper and more efficient communications and processing technology and more mature software platforms has made the incorporation of IoT technology practical and efficient for smaller entities and entities outside of traditional “technology” oriented areas.

Unfortunately, as with all new technology, there are attendant risks. Just as with the mainstreaming of web technology and smartphones, both suppliers of IoT components and deployers of IoT systems risk exposure to intellectual property liabilities. In this article, we attempt to address some of the risks and how best for the parties involved to protect themselves from liability.

PATENT LITIGATION ACTIVITY AND THE INTERNET OF THINGS

Between 2016 and 2017 over 700 patent litigations were filed related to IoT technology. The vast majority of these suits were filed by Non-Practicing Entities (NPEs) who did not practice the patented technology commercially. In some cases, these may be early innovators who were unable to commercialize their technology and are seeking to monetize their intellectual property; in other cases, the plaintiffs may

be dedicated patent monetization entities who have acquired the asserted patents.

These suits may present particular risks for IoT deployers and component suppliers for several reasons:

- First, the defendants may be smaller entities or entities not in traditional technology spaces who are not seasoned patent litigation defendants.
- Second, IoT deployers often do not make the accused technology and may not have the information necessary to defend themselves effectively against patent infringement claims.
- Finally, the multi-component nature of IoT patent claims may present complex indemnification and defense issues for both deployers and vendors of IoT technology.

For example, take U.S. Patent No. 6,594,579, which was the subject of a declaratory judgment action in the Northern District of Ohio. The claims of the ‘579 patent recite monitoring fuel-efficiency related metrics in a vehicle (speed, miles traveled, fuel consumption, etc.), transmitting those metrics to a remote server, and using those metrics to analyze the vehicle’s fuel efficiency. The claimed system involves at least the following components:

- Embedded automotive sensors to measure the vehicle characteristics
- A wireless modem to transmit the measured values
- A database for storing information collected from vehicles in a fleet
- Analysis software

A real world deployment of these components might also include some manner of terminal or user interface for reviewing the analyzed results and even integration into more general fleet management software.

Because no single company is likely to have this type of capacity in-house, the infringing system may be created from components purchased from multiple vendors. This presents significant issues in terms of assigning liability and gathering the information necessary to effectively defend the IoT deployer from infringement claims.

INDEMNIFICATION AND THIRD PARTY LIABILITY

A defendant charged with patent infringement for use of a third party's technology might normally seek indemnification from the vendor who provides them with the infringing component. Similarly, a component vendor having to indemnify against such claims knows how its products operate and has the information and expertise to defend itself effectively.

However, the complicated nature of IoT infringement claims can make this approach problematic. A patent infringement defendant may have multiple providers for the accused system and need to carefully examine the indemnification terms of its contracts. Many indemnification terms are limited to infringement claims arising solely/primarily out of use of the purchased components and exclude systems that add to the functionality of the purchased components.

Similarly, a component vendor that has agreed to broad indemnification terms may find itself defending an infringement suit based on unexpected uses of its technology in combination with third-party technology. In addition to the additional cost exposure, the

component vendor may not have the in-house technical expertise or knowledge necessary to contribute to its defense effectively.

Accordingly, these possibilities require that both vendors and IoT deployers exercise care in the indemnification terms to which they agree. Companies deploying IoT systems may wish to negotiate the broadest indemnification terms to ensure they are not left without indemnification. Another alternative would be to utilize a single system vendor or component integrator who can accept full responsibility for any infringement arising from its deployed designs.

Conversely, component vendors should be proactive in seeking indemnification terms that protect them from potential exposure for infringement arising from combined systems. Depending on the nature of the relationship, vendors may wish to fully investigate the intended deployment of their technologies to ensure they are not potentially forced to defend and indemnify their customers against complicated infringement claims involving complex multi-component systems.

PREVENTING AND DEFENDING AGAINST IOT INFRINGEMENT CLAIMS

In addition to ensuring sufficient indemnification, parties should, to the extent feasible, try to avoid known threats. To the extent that a party's competitors have been the target of infringement suits, it may be worthwhile to seek a freedom-to-operate opinion from counsel. Such an opinion can assess whether a party's technology potentially infringes known patents and suggest modifications to further shield against liability. Such opinions can also have the added benefit of protecting a party against charges of willful infringement.

Should a patent-holder bring suit, several developments over the past few years have made it significantly easier to defend against IoT-based infringement claims. First, patent claims directed towards information management functions typical to IoT systems may be susceptible to patent eligibility challenges under 35 USC §101 and can be resolved under early motions to dismiss. Second, patent claims directed towards software and network functionality have not enjoyed high success rates in Inter Partes Review challenges before the US Patent Office. Finally, the Supreme Court's 2017 TC Heartland decision has made it more difficult for plaintiffs to bring suit in their venues of choice. These three factors may place defendants in a stronger position defending IoT-based patent infringement claims and may make it easier to obtain settlement on favorable terms or obtain resolution without extensive litigation.

KEY CONTRACT CONSIDERATIONS FOR CONNECTED DEVICES

Dustin DuBois, Ice Miller LLP

As with potential patent infringements risks that should be considered, companies should also scrutinize their various agreements to ensure they cover connected products. Revising, and even for the first time entering into, contracts to ensure risks are understood and properly allocated among parties, consents to use and exploit data are obtained and suppliers of parts, goods and services are held to contractual standards to achieve the connectivity and security required today are paramount.

DEVELOPMENT ACTIVITY AND OWNERSHIP OF THE UNDERLYING INTELLECTUAL PROPERTY:

Many companies are, for the first time, developing connectivity for their products or including connected devices in their service offerings – each of which may involve third-party developers or employee developers. Regardless, it is important for companies to ensure they have contracts in place with developers and employees alike, so any new intellectual property developed for the company is owned exclusively by the company. Existing contracts may cover the basics, but should be reviewed to ensure they adequately cover all aspects of development, from hardware, to software, to the conceptual workflows that are created. These development aspects may raise issues of copyright, patent, trade secret and other intellectual property rights, and these contracts can ensure the company's ability to license or transfer these rights through its sales and distribution network and in the context of a merger or acquisition of the company.

SUPPLIER / VENDOR AGREEMENTS:

Companies should also ensure their agreements with suppliers (of all types) cover key aspects of their connected devices. The types of supplier relationships that are important to consider may include: suppliers of hardware, subassemblies and communications systems, as well as vendors for services such as mobile communications and hosting or cloud storage. Some of the key provisions of these agreements include functionality warranties, product recall considerations, uptime and processing performance and data security assurances. It is important to have an understanding of the key areas of risk when crafting or revising supplier or vendor agreements. For example, with respect to mission critical products or services, companies should be sure their suppliers are on the hook for key aspects they can control such as quality, reliability, uptime

and security. Suppliers' form contracts are often missing adequate provisions, so it is crucial to work with experienced counsel to assist in drafting, revising and negotiating them.

Customer Agreements – Terms of Use:

The agreements suppliers have with their customers and end users tend to be highly customized to meet specific state laws and regulatory requirements, use scenarios and each company's unique balance between reducing risk and standing behind the company's products and services. Key provisions of customer agreements often weave together to provide just the right risk allocation between the company and its customers. Those provisions often include:

- Product functionality warranties
- Limitations of liability, disclaimers of warranties (including for data loss, error-free and full uptime operation)
- Indemnity to cover potential third-party claims from customer activities and negligence
- Consents for data access, use and even use of aggregate, statistical or anonymized data for purposes beyond that customer's use of the product (such as benchmarking or dashboards for other customers)

While the risks identified in this article are common to many types of products, the introduction of the IoT and connected devices adds additional issues which must be addressed. Companies should work with counsel knowledgeable in this industry to discuss which of these risks (and others) need to be addressed.

FIVE SECURITY TIPS FOR PROTECTING YOUR CONNECTED BUSINESS

Stephen Reynolds and Matthew Diaz, Ice Miller LLP

With the dawn of 5G connectivity on the horizon, there will be an explosion of Internet of Things (IoT) devices in society. By 2020, there is projected to be over 30 billion IoT devices worldwide. Bain & Company projects that combined IoT markets will grow to nearly \$520 billion by 2021—nearly double what was spent in 2017. Some of the sectors that will have the largest IoT market share include Smart Cities, Industrial IoT and Connected Health.

However, with the influx of IoT devices will come a wave of security risks for all your internet connected devices and the data they collect. Here are five tips for your business to consider as it introduces IoT devices into its supply chain:

1. Change Your IoT Device's Default Password: IoT devices may come with pre-installed passwords which can easily be compromised. You should consider changing your device's default password to one that aligns with the National Institute of Standards and Technology's (NISTs) password guidance. Some factors for implementing a NIST-compliant password for your IoT device include:
 - Not imposing composition rules, such as requiring a mixture of different character types;
 - The ability to use all special characters, but not being required to use special characters;

- Restricting the use of dictionary words;
- Restricting the use of context-specific words, such as the name of the device; and
- Restricting the use of repetitive or sequential characters.

2. **Maintain a Separate, Secure Network for Your Devices:** Having a separate network that is behind a firewall and constantly monitored can help ensure the security of your IoT devices. Consider having a virtual private network (VPN) that can encrypt your internet connection to ensure that data flowing through your IoT devices is secure.

3. **Implement a Robust Patch Management System:** Hackers will never take a break from trying to compromise networks and new technologies. This is why installing system updates and patches to address newly discovered security flaws is critical. Be sure your IoT devices are updated regularly or automatically download patches when released.

4. **Avoid Unsecure, Public Networks:** When connecting to Wi-Fi connections with your IoT devices (including mobile phones, laptops and tablets), be sure the network connection is secure and password protected. Unsecure networks can be easily manipulated by hackers and can put your device and data at risk.

5. **Read Your Device's Privacy Policy:** Companies draft privacy policies to tell you how they collect data, use data and with who they will share that data. However, not all companies' privacy policies are the same. It is important for you to understand what happens to the data your IoT devices collect and how that data is used and stored. For example, in the health application space, an interview with IIT-Chicago Kent College of Law professor Lori B. Andrews highlighted that of a random sample of the top 400 health applications on the market, over seventy percent (70%) of them shared intimate health information with data aggregators, with some aggregators subsequently providing that information to life and health insurers. Furthermore, of the random sample of health applications in the study, an overwhelming majority of them did not even have a privacy policy.

CONCLUSION

The IoT presents tremendous opportunities including greater cost-savings and productivity, but as with any new technology, it brings new intellectual property challenges and unique contract challenges, in addition to the risk of complex patent infringement claims. Careful management of commercial relationships, contract terms and security risks is necessary to minimize risk going forward.

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Accelerating new value creation through Customer Opportunity Development, Lean Strategy and Lean Innovation. Identifying new growth opportunities faster and accelerating the value creation process through lean business experiments are key activities for Roche in order to increase the likelihood that investments deliver customer and business value.

DEFINING CUSTOMER VALUE THROUGH LEAN STRATEGY

At Roche Diabetes Care, our goal is to improve the quality of life and medical outcomes with affordable and cost effective products and services for people with diabetes, their personal care givers, health care professionals, and payers.

One of the strategic business objectives for Roche Diabetes Care is to transform our organization to become an end-to-end provider of fully integrated and connected products and services. Being able to offer products and services connected across therapies, patients groups, health care professionals, and payers, comply with regulatory requirements while being affordable and cost effective is a tremendous challenge. On top this, our products and services must meet the unmet needs across all stakeholders.

While we continue to execute our existing business model by addressing known customer and market needs better, faster, cheaper,

and more cost effective, we have to establish new skills, competencies, and a mindset in order to compete in an increasingly dynamic and complex diabetes care market environment. We need to shift our focus from “Execution” to “Search”: searching and identifying unknown customer problems, new growth opportunities, and new ways to deliver better quality of life value, affordable medical value, and sustainable business value.

There are few steps we are taking to organically increase the likelihood our investments deliver sustainable customer and business value faster and more effective when searching for new growth:

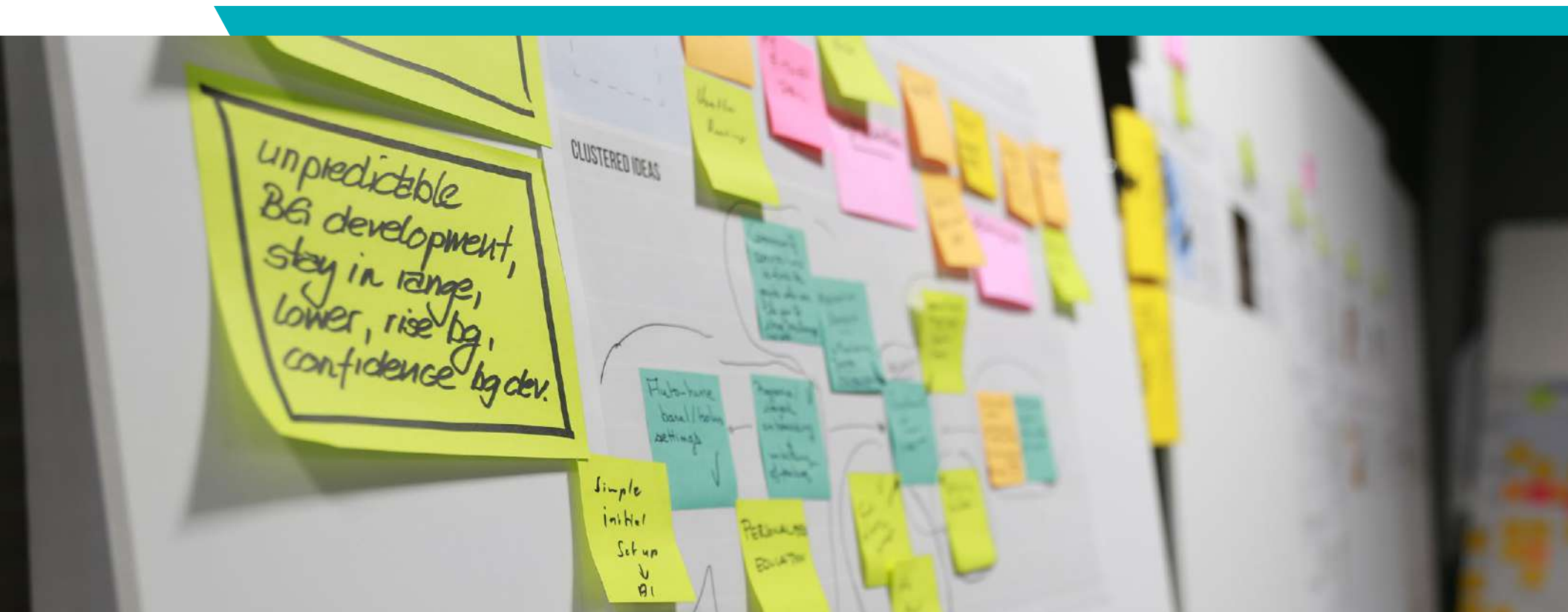
- 1. Insights Discovery & Customer Opportunity Development:** Gaining customer empathy and identifying growth opportunities (defined by segments that share unmet customer needs) is key to inform and accelerate important business decisions. Empathy

is gained by building a deep and rich understanding of people's experiences living with diabetes (patients) and caregiver's experiences supporting and treating people with diabetes (family members, healthcare professionals). Our goal is to gain validated insights about their problems, barriers, challenges, motivators, social-, functional-, and emotional needs and the context of those insights (where, when, with whom, how often, etc). We discover those insights through a variety of deep qualitative, exploratory and participatory research methods where we visit people in their natural environment, applying research techniques borrowed from social scientists, psychologists, anthropologists, design researchers, and experience designers. Through quantitative validation studies, we then surface opportunity segments:

underserved (they share many unmet needs), served (their needs are met), and overserved (their needs are well served). These segments are the cornerstone to inform and accelerate the value creation process because they allow the organization to make deliberate choices on which customer segments and customer opportunities to target for value creation and equally important, which segments and opportunities not to target for value creation and why not.

2. Lean Strategy Development & Strategy Validation:

We have implemented a process called lean strategy using "Strategy Sprints," where we assess customer opportunities and opportunity segments from various intelligence angles



such as Market Access, Medical & Scientific Affairs, Competitive Intelligence, trend research, Data Strategy, etc., to then develop business unit specific strategies (growth strategy, portfolio strategy, product strategy, and commercial strategy). The growth strategy is a key deliverable and defined by three steps: 1. “Where to Play” (defined by customer opportunities and market constraints), 2. “How to Play” (defined by products, services, business models), and 3. “How to Win” (defined by customer value and business value delivered through products, services, and business models). The outputs of this process are strategic growth paths and a strategy validation plan to test and validate the strategy, and to prove the strategy is investment ready and valid before large investments are being approved for developing, commercializing, and scaling new solutions.

3. Lean Innovation:

The lean innovation approach is currently being tested in one of our new business units. This approach allows us to test and validate the riskiest assumptions identified in our growth strategy, product-, or commercial strategy. Our lean innovation approach combines four different mindsets and methods: Customer Opportunity Development, Lean Startup, Design Thinking, and Agile principles. We are running Lean Sprints (5 days) followed by an Accelerator (12 week long program consisting of 2-3 week sprints) using small, cross-functional “special teams” . These teams develop and deploy rapid, lean customer and business experiments with the desired outcome of gaining validated learnings about customer needs, customer problems, and eventually gaining evidence about customer value and business

LEAN STRATEGY



Continuous insights discovery and validation of customer value and business value inform changes to the original strategy. The result is an emerging strategy.

value through “Need-Solution Fit” experiments and “Product-Market Fit” experiments. The desired outcome of an accelerator program is to inform the decision if further investments should be made or not, and if so how: do it yourself, partner, acquire, or licence.

While there is no such thing as a final or perfect innovation process when it comes to searching for, developing, and commercializing new customer value, it is clear these three steps in the early stage of our value creation process allow us to inform and accelerate important business decisions faster and with more confidence due to the rigor, discipline, and creativity applied. The cornerstone of the three steps is the Lean Strategy approach because this is the inflection point where our company has a unique opportunity to decide on the priorities and the value it wants to deliver to people in need for better solutions,

and even more important how it wants to deliver those solutions in a feasible, sustainable, and affordable way.

Then it's about aligning actions with intentions: developing and allocating the right skills, developing the desired “innovation culture,” and enabling and empowering people to validate, execute, monitor, and refine the strategy. Still, it is far from being a success story, and it never will be, because corporate innovation programs have high failure rates. The ultimate competitive advantage for any organization in search of new customer and business value is how fast and cost effective it can learn about customer and market opportunities, and what solutions address those opportunities better, cheaper and more cost effective while creating a sustainable business model.

Find out more – www.roche.com





Outside Source



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Interactive design creates customer engagement, and good interactive design happens when brand leaders and software engineers put their heads together to build a better digital experience. After 30+ years' experience working in the intersection between brand strategy and emerging technology, I've learned what it takes to strengthen brands in a changing digital environment to help them avoid erosion.

GIVE IOT THE INTENTION IT DESERVES

The pace of technological change means customer experiences are more connected and 'smarter' than ever. The transformative role of IoT in our lives is no secret; we see it every day in our cars, homes and offices.

As consumers, we embrace and adopt IoT when we know our lives can be better or easier with the aid of technology. As business leaders, we realize how quickly we adapt helps us build a competitive position in the market or grow our audience, depending on how well we deploy connected technology.

The topic deserves more than just awareness and prompt attention. The world of IoT deserves our dedicated intention.

Intentional design implies more than simply a high priority. IoT requires purposeful and conscious consideration on three primary fronts: the customer journey, the interface and the technology.

THE CUSTOMER IS ALWAYS MOVING

Your market and audience are always in motion; toward progress or away from the things that hassle or hold them back. At Outside Source, we work hard to keep the idea of customer connection close at hand. What is difficult to do is actually have deep empathy for the audience's customer journey.

A customer journey represents more than a persona, ideal target audience, or data point. Each journey is dynamic and emotional, which requires empathy on our part. When we bring empathy to the conversation of IoT, we consider what ways technology might help, ease, or even frustrate our customers.

Not everyone is an early adopter, but everyone is in motion towards a better solution based on their their unique point of view and goals. Customers are looking for ways to do what they do easier and with

more insight. At the heart of an empathetic journey is an intentional consideration for an IoT solution which will make your audience say, “Thank you for the help.”

GOOD DESIGN REMOVES NON-ESSENTIALS

Visual design is often the most overlooked aspect of IoT solutions, but not the place to cut corners.

User experience and design principles outside your category are influencing customer expectations at a rapid pace. Innovations in operating systems, hardware, financial systems, wearable devices, or even the way we hail a cab are creating new and higher expectations that impact the experience with your customer.

Intentional design is more than simply what the competition is doing or not doing. IoT experiences require us to envision how design might connect with your brand experience, from what ecosystem you choose to how customers first engage the user experience.

It’s our job as technologists to be in tune with our customers and remove the non-essentials to make an elegant and streamlined experience, delivering value at every step.

TECHNOLOGY THAT BUILDS TRUST

When you consider what technology to use, you are going to have no shortage of options. Remember to choose with the customer perspective as your primary focus.

Yes, you will want to be able to efficiently support the tool and make updates. Yes, you need good data, cloud infrastructure, and scalability. But as you choose your ecosystem or tech stack, have as much of

an open mind as you can with the way the customer experience is affected by your choices.

INTENTIONAL CONNECTED EXPERIENCES

As you approach the question of how IoT might impact your business, give it all the intention you can. The goal of IoT should be centered on the people you serve – the customer. With that in mind, let’s continue to build innovations and connected experiences that foster trust and deliver value time and time again.

Find out more – www.outsidesource.com





CREATEABILITY



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Expert on how technology can assist professional and informal caregivers to watch over people to help them independently and safely, with less intrusion, and improved outcomes. Technology can range from simple devices that verify the most basic activities of daily living (ADLs) to more sophisticated things such as measuring vital signs and verifying medication compliance.

AGING-IN-PLACE AND DISABILITY SUPPORT TOOLS

HOW IS IOT AFFECTING OUR SECTOR?

IoT is creating unique opportunities in our business sector by enabling CCI to deliver new services and products that help people with special needs at home and in the workplace.

The key is to focus on the business case, not the things in the Internet of Things. Specifically, IoT is helping CCI reduce costs to agencies, Medicare waiver programs, and support networks by maximizing the independence of those with special needs.

CCI is one of the largest recipients (for companies under 10 employees) in Indiana of federal grants from the Small Business Innovation Research program (SBIR). All of CCI's IoT-based products are the result of commercialization efforts from our evidence-based research.

That's why we have been using the principles of IoT for 15 years. While it has been called many things since 2003, our philosophy has remained the same – use technology to supplement the traditional caregiver model to reduce costs and intrusion, while increasing independence.

A few of the specific areas where IoT has helped CCI improved services and delivery of products:

The Independence Family – an intelligent network of wireless sensors that work in concert with tablet-based prompters to help people stay safe, healthy, and independent.

Behavioral supports – Sometimes people with intellectual disabilities (such as Down Syndrome, Autism, or a brain injury) have a dual diagnosis, including behavioral health issues. CCI's in-home sensors

detect the sound of yelling at roommates, slamming doors, pounding on walls, or throwing a toy called a “tantrum” (with an integrated sensor). The individual is then guided by a protocol developed by a psychologist to more quickly return to baseline.

CCI’s prompting and sensing technology is now being used by Qsource and the Atom Alliance to help people stay engaged with their health and better manage their Type II Diabetes.

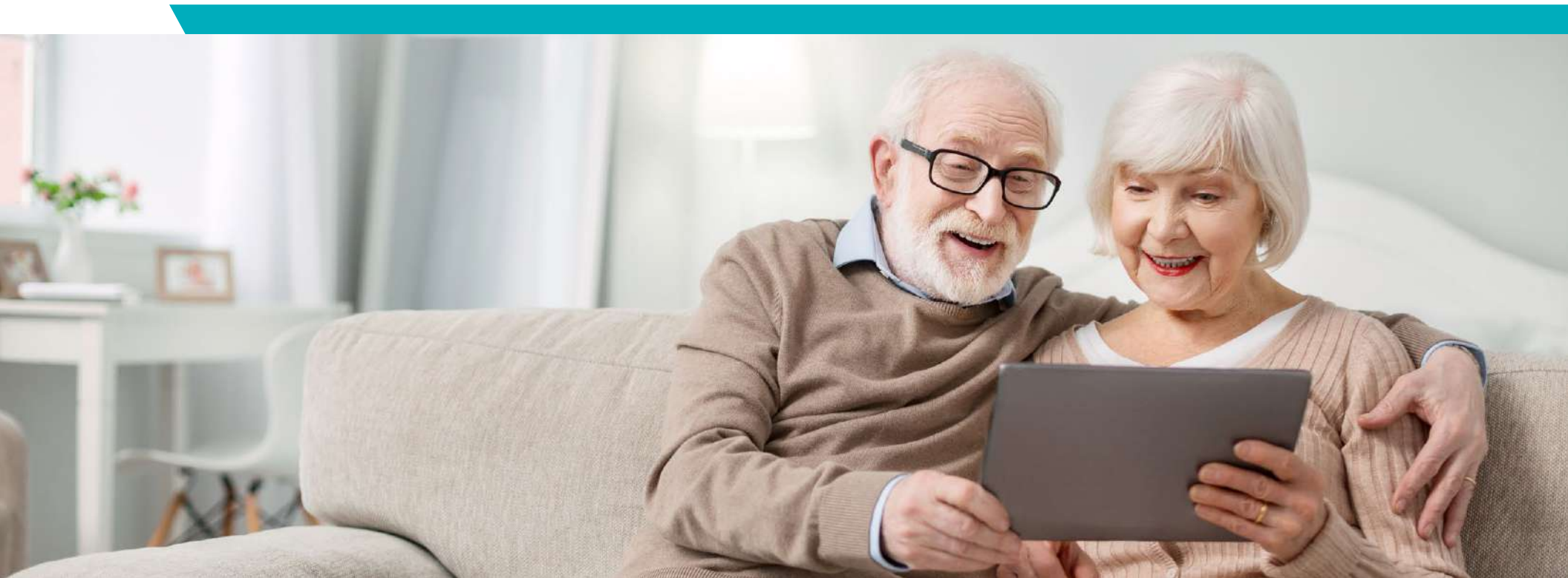
“**To date, CCI’s IoT products have generated over \$4.6 million in sales.**”

Many new IoT-based products are currently under development.

Although some of our customers fear change, the future is bright as more clients and the agencies supporting them embrace the technology and can quickly generate reports on their clients.

While CCI has traditionally only marketed to continental North America, it is developing a worldwide network for rollout of our technology worldwide. This will bring challenges in terms of wireless standards and our equivalent of the FDA, and we welcome these challenges.

Find out more – www.createabilityinc.com



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THE INTERNET OF THINGS (IOT): RISK AND REWARD

Enabling Innovation while Addressing Cybersecurity Risks

It's predicted that by the year 2020, there will be over 50 billion connected devices in the world. From customer insights to safety and surveillance, there are a multitude of benefits to the data analytics possibilities this connectivity creates, but the rewards do not come without risk.

When everything is connected, everything is at risk.

A wider depth and breadth of data availability creates more opportunity, but it also increases the possibility of cybersecurity attacks and data breaches. Several recent studies have found that 70% of the most commonly used IoT devices contain vulnerabilities, including password security, encryption, and authentication issues.

IoT devices are producing an unprecedented volume and variety of data, and the growth potential of this phenomenon is staggering. Gartner predicts that more than half of new business processes and systems will include an IoT component by 2020.

The key to making IoT a success is balancing innovation with security. All technology involves the acceptance of rational risk, and IoT is no different. The value of IoT, which is increasing and strategic, must be balanced against its risk. An overemphasis on security can limit the potential of IoT and insight that can be derived. A careless or rushed implementation can put organizations and individuals at risk.

THE BENEFITS OF CONNECTIVITY

Although there is novelty in a world of connected hardware devices, the true value of IoT lies in the richness and timeliness of the data it provides. Significant insight and value can be unlocked from this data through the application of modern analysis techniques. The ability to combine and analyze datasets to better understand people, things, and situations creates vast opportunities for improvements in customer service, safety and security, the understanding of human sentiment, and even some yet undiscovered areas of improvement.

Within IoT, sensors generate data from video feeds, mobile geolocation information, product usage, social media, environmental sensors, and computer or software generated events. With deep data analysis across devices, timeframes, and locations, organizations are equipped to, among other things:

- Develop new business opportunities by better understanding customer requirements, implementing new process improvements, or making better investments with data-driven insights
- Predict the needs of their customers and respond in a proactive way
- Increase revenue growth by identifying new ways to create value, reduce expenses, and increase productivity
- Make better, more informed business decisions with access to real-time data
- Use cameras and sensors to help protect against physical threats and oversee disaster management and recovery system initiatives

- Enhance the human experience by increasing access to information and improving the ability to communicate more effectively and efficiently
- Participate in the development of “smart cities” that include services such as smart grids, smart waste management, smart traffic control, and smart utilities

The promise and possibility of IoT is virtually unlimited, but the potential impact to an organization’s security posture must be carefully considered.

CYBERSECURITY AND DATA RISK AND RESOLUTION

Because of its widespread proliferation in both business and consumer lives, IoT presents those with malicious intent a much more appealing “attack surface.” Not only can organizations enable a compromised enterprise by creating and providing sensor equipped products and services, but individuals have the potential to put themselves at risk for personal safety issues and identity theft by engaging with IoT devices.

Threats and vulnerabilities associated with IoT include counterfeiting, service denial, password-based attacks, and phishing. These threats must be mitigated with security controls, such as data protection, security monitoring and analytics, regulatory compliance, and identity and access management.

When developing an IoT-ready cybersecurity system, the organization’s broader network—including clients, customers, suppliers, vendors, collaborators, business partners, and alumni—must also be considered. Without protecting every facet of the business

ecosystem, the entire system can be at risk. Those responsible for IoT cybersecurity should consider:

- Designing and implementing a threat intelligence strategy to support business decisions
- Fully understanding vital assets and the value of their protection
- Using data analytics to anticipate where and when threats are most likely to occur
- Implementing system architecture approaches that prevent unauthorized access in one area of the technology from proliferating through the entire system
- Ensuring all those within the organization understand the need for strong governance, user controls, and personal accountability
- Developing a well-functioning Security Operations Center to help detect threats, produce relevant reporting, and enable better decision-making, risk management, and business continuity

In response—and in order to both protect themselves and take advantage of IoT possibilities—organizations will have to re-architect their data and analytics capabilities, create new governance policies and practices, and adopt new data management technologies and platforms.

Cybersecurity initiatives will also have to be reconsidered and should include the ability to:

- Lock down data security across the cloud and on-premise
- Detect anomalies in sensor data
- Maintain strong data encryption at every level
- Develop audit trails for activities throughout the enterprise
- Institute a robust data governance
- Implement a robust backup and disaster recovery plan
- Allow for dashboard creation where potential threats can be identified by leveraging data science and machine learning approaches
- Enable IT to quickly identify and restrict access to data assets in the event of a cyberattack
- Allow IT to make the right balance of data available to the data engineering and data science teams so the enterprise can remain secure without stifling business innovation

ENSURING LONG TERM IOT SUCCESS

An organization's agility and nimbleness are the key to capitalizing on trends such as IoT. That doesn't mean, however, preparations shouldn't be made before engaging IoT innovation or quality, compliance, and security should be left out of the equation.

Organizations should be prepared to answer questions, such as:

- Who owns the data?
- How is data quality, usability, and security ensured?
- What are the goals driving data collection?
- How will data analytics be managed?
- How will data compliance best practices be instituted?

“**One of the biggest mistakes an organization can make is waiting until the “perfect time” to take advantage of IoT’s innovatiovn potential.**”

All technology involves the acceptance of rational risk, and IoT is no different. The value of IoT, which is increasing and strategic, must be balanced against this risk. Therefore, due diligence is a necessary component of success—those engaging with IoT innovation must stay educated, informed, and ahead of the curve.

The most important premise to remember is this: When everything is connected, everything is at risk. Those who successfully innovate with IoT will take all necessary precautions to ensure security and privacy implications are addressed and safeguarded—for their benefit and for the common good.

Find out more – www.ksmconsulting.com

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THE FUTURE OF IOT

At the heart of Indiana's economy sits the three major industries of manufacturing, logistics, and agriculture on the cusp of being completely transformed by technology. It's critical to arm our companies and engage our entrepreneurs in this transformation, and IoT must be part of our strategy to maintain our industry leader status for the next generation of Hoosiers.



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BRINGING TOGETHER THE FOUNDATIONS FOR IOT IN INDIANA

BY JASON PENNINGTON | EXECUTIVE DIRECTOR, INDIANA IOT LAB

Several Indiana initiatives and organizations gained traction, launched, and further developed the connected technologies footprint in Indiana in 2018. Punctuated by the opening of the Indiana IoT Lab in Fishers, momentum is building within the state for support of our innovation economy. Major initiatives announced, opened, or in-progress in 2018 include:

- Wabash Heartland Innovation Network (WHIN), North Central Indiana
- Innovation Point, Evansville,
- The Indiana Connected Health IoT Lab, Fort Wayne
- Idea Center, South Bend
- Discovery Park District, West Lafayette
- Dimension Mill, Bloomington
- 16 Tech, Indianapolis

These activities represent more than a simple need for flexible working space. They are evidence of communities working together towards a connected future. This movement serves to envision and enable the connected hardware and platform environments for Indiana's entrepreneurial and established tech communities that have launched and grown some of the most successful Software as a Service companies in the market.

2019 WILL BE HIGHLIGHTED BY NETWORKS, EDGE DEVELOPMENT, AND INCREASING PLATFORMS AS A SERVICE MODELS

The Internet of Things economy will continue to grow in 2019. For Indiana's world-class manufacturing, logistics, and agriculture industries, the ideas of 2018 will present opportunities for additional pilot facilities, deployed technologies, and larger test installations.



To support these opportunities, the Indianapolis market will be poised to make strong entries into the cellular market as a test city for both AT&T and Verizon's 5G technologies. 5G represents a series of new opportunities for connected population centers in commercial, consumer, and industrial installations. Additional use cases for LPWAN and LoRa (long range, low powered, wide area networks) will continue to gain traction as more connected products enter the markets. We can expect to see new Bluetooth® technology standards providing additional capabilities, range, and networking options from local entries in the emerging Indiana sectors for smarter and safer buildings and connected medical devices.

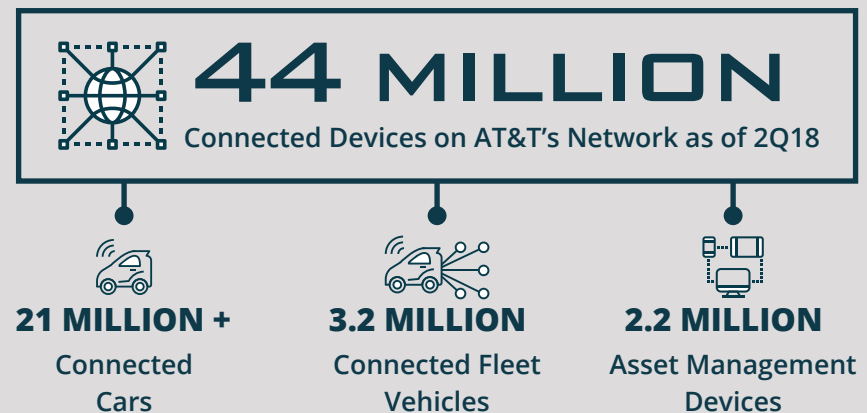
Local end user and development enterprises are increasingly transitioning beyond the "app for that" phase of their connected businesses to pursue deeper opportunities presented by growing platforms. 2018 represented many examples for stand alone developments, connected vision components, voice enabled products, and for-purpose devices. In 2019, this range of developments will mature as willing adopters demand consolidation and simplicity rather than a fragmented ecosystem of installations and technologies.

The Indiana Internet of Things market will benefit in 2019 from increasingly powerful hardware options, more end user deployment strategies, and a growing developer community. The key technology gains behind the continued growth for IoT throughout the state will perhaps happen even closer to where the action is - at the Edge or device level and with larger scale or intra-company and supplier ecosystems, in the growing FOG layers - the concept of bringing cloud computing closer to the network edge, rather than purely from device to cloud. This is not only a function of increasing deployment generating larger amounts of data to be processed and demands

AT&T IS CONNECTING YOU TO THE INTERNET OF YOUR THINGS

We're operating in a world where virtually anything can be connected to the internet. AT&T is delivering the future to our customers by allowing them to connect in new ways - enabling the transformational benefits of IoT. There's never been a more exciting time for IoT. The mobile revolution has transformed the way we do just about everything - creating a multitude of possibilities in our connected society.

"We connect everything from Maersk shipping containers to coolers and vending machines," says Chris Penrose, president of the company's IoT business. The US carrier is working to capture every opportunity in the mad-paced IoT market, and not just the big-ticket wins. "AT&T is a one-stop-shop," says Penrose. "From two folks in a garage to the largest companies in the world - to help ideate, deploy and manage IoT solutions." Its terms of engagement are that the technical solution is repeatable, and the business solution is scalable. The false steps are fewer; business in the IoT sector is taking form, finally.



for speed, but also a function of sinking costs in the deployment and scaling phases for many underdeveloped IoT projects. In short, why allocate, design, and finance cloud services for enhanced analytical services without a defined use case or business purpose?

While the cloud services environment continues to be consolidated at the hosting level by large scale providers like Amazon, Google, IBM, and Microsoft, the regional and local firms are expanding their services to create customizable environments requiring dialog and design often difficult to manage without localized partnerships. To support these efforts, concepts for growing the opportunities for machine learning, localized artificial intelligence, and integrations driven by partnerships to create near end to end platforms will dominate the tangible 2019 IoT narrative throughout the State of IoT.

AN EYE TO THE FUTURE

As 2019 progresses, the future of IoT and its continued iterations will be one to watch. At a basic level, there remains an emphasis on developing further understanding and confidence around cyber security programs to support and complement the acceptance of connected products and systems. In these early days of the tangible Internet of Things, the existence of potential security liabilities and threats in first to market and often underdeveloped products presents a cautionary barrier to broader acceptance and subsequent adoption. Furthermore, within the US market, a lack of established and structured data protection and consumer privacy regulations similar to the standardized GDPR (General Data Protection Regulation) in Europe not only impacts consumer trust, but places unnecessary restraints for entrepreneurial concept to product realization in the form of confusing, fragmented, and dynamic market requirements. A

last theme to watch in 2019 remains the underdeveloped technologies like Blockchain and its promising role in connected business. Beyond the romanced currency reported in context of stock valuations exists a strong technology. The ideas for developing Blockchain to streamline digital ledgers, document product transfers through increasingly complex supply chains, and strengthen fraud prevention tactics are very real use cases for the technology. However, the common understanding suggests years before true adoption at scale.

OUTLOOK

For all that has been done, there remains much work to do. As a state, we need to better understand and harness a more developed funding environment to keep our best and brightest entrepreneurs in Indiana. There also exists many unfulfilled opportunities for established organizations to mentor, support, and develop alongside the entrepreneurial community. With 2018 behind us, we can look back and be proud of the regional technology initiatives, frequent emphasis to support high tech startups, and public-private partnerships which created investments in future ready infrastructure throughout Indiana.

“**Concepts for growing the deployment of machine learning and artificial intelligence opportunities at the Edge or closer to the action will dominate the tangible 2019 IoT narrative throughout the State of IoT.”**



INDIANA *iot* LAB

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