



Overview of IIC and Industrial Analytics: Fueling the IIoT Revolution

Wael William Diab

IIC Liaison WG Chair, Technology WG Chair, Industrial Analytics TG Chair

IIC SC Member

Senior Director, Huawei

3rd RRI International Symposium, November 2017





Acknowledgements

Eric Harper (ABB)

Shi-wan Lin (Thingswise)

Stephen Mellor (IIC)

Will Sobel (Vimana)





Agenda

Overview of IIC

Industrial Analytics Task Group: Overview and Motivation

Industrial Analytics Framework (IIAF)

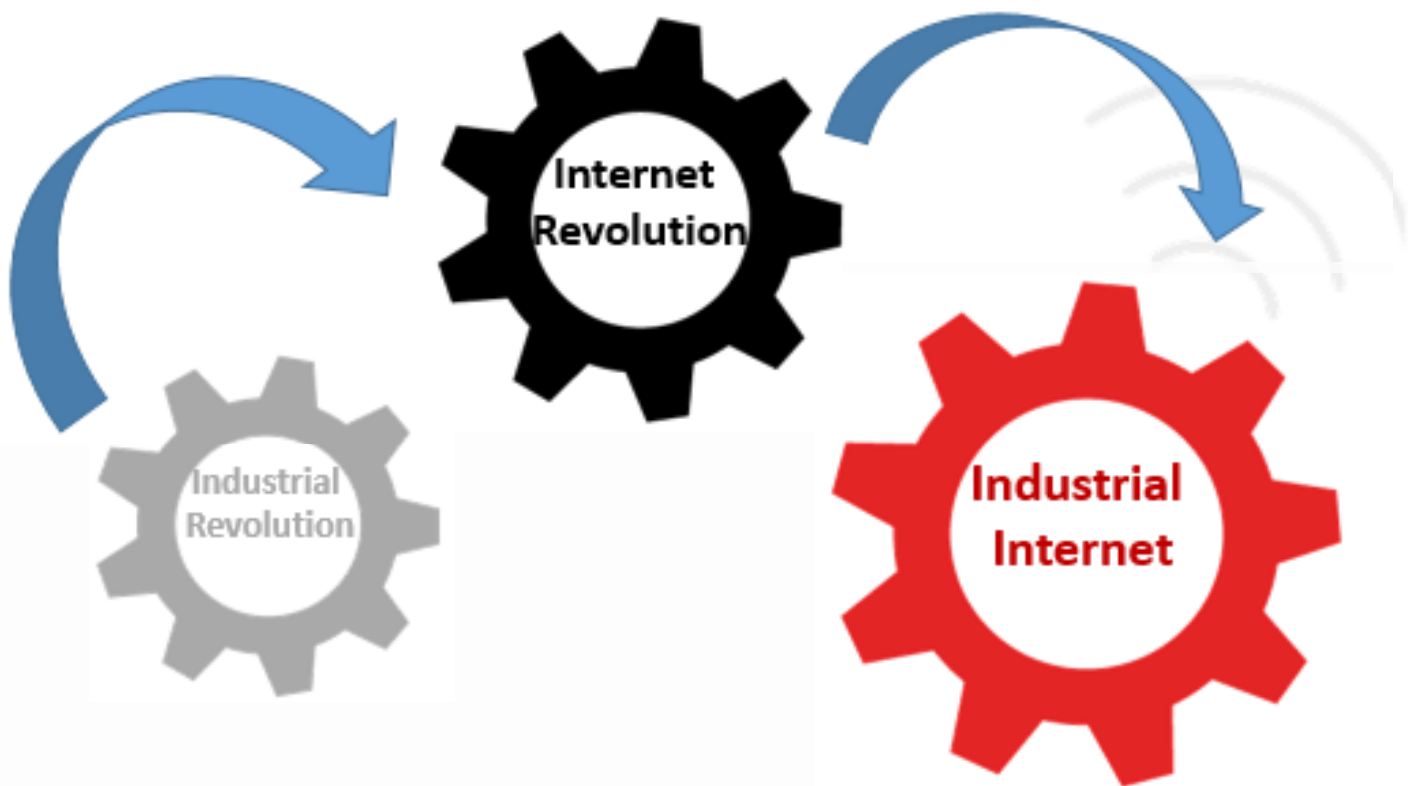
Looking Ahead: What's on the Horizon for Industrial Analytics

Concluding Remarks

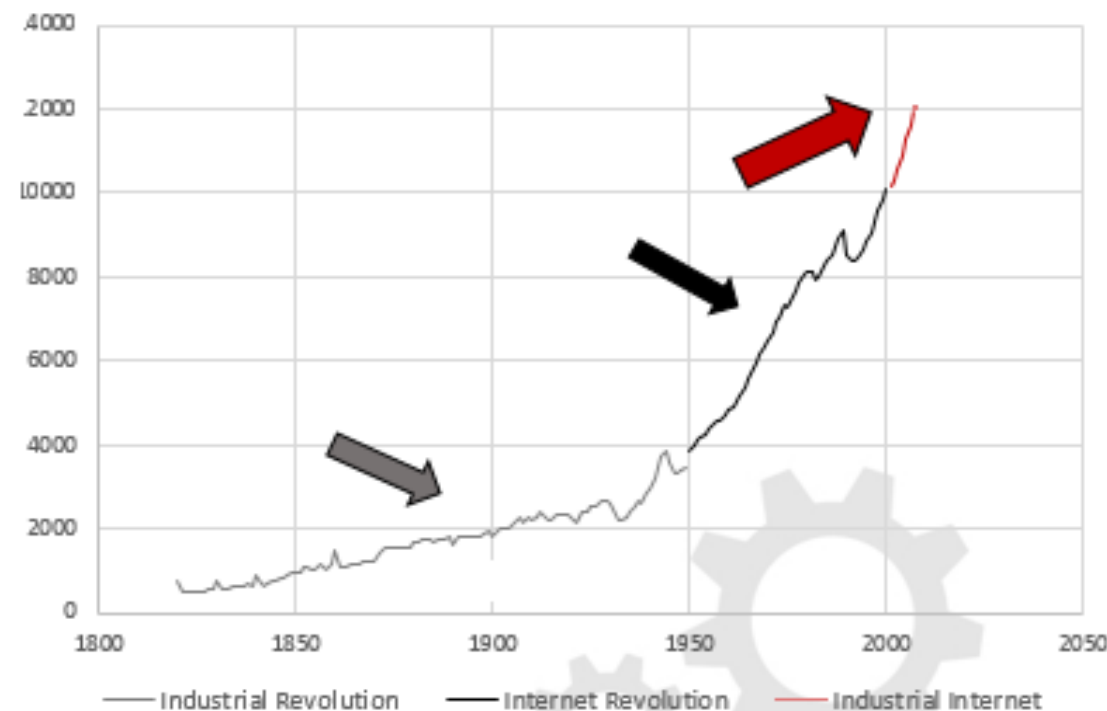




The Industrial Internet is leading the next economic revolution

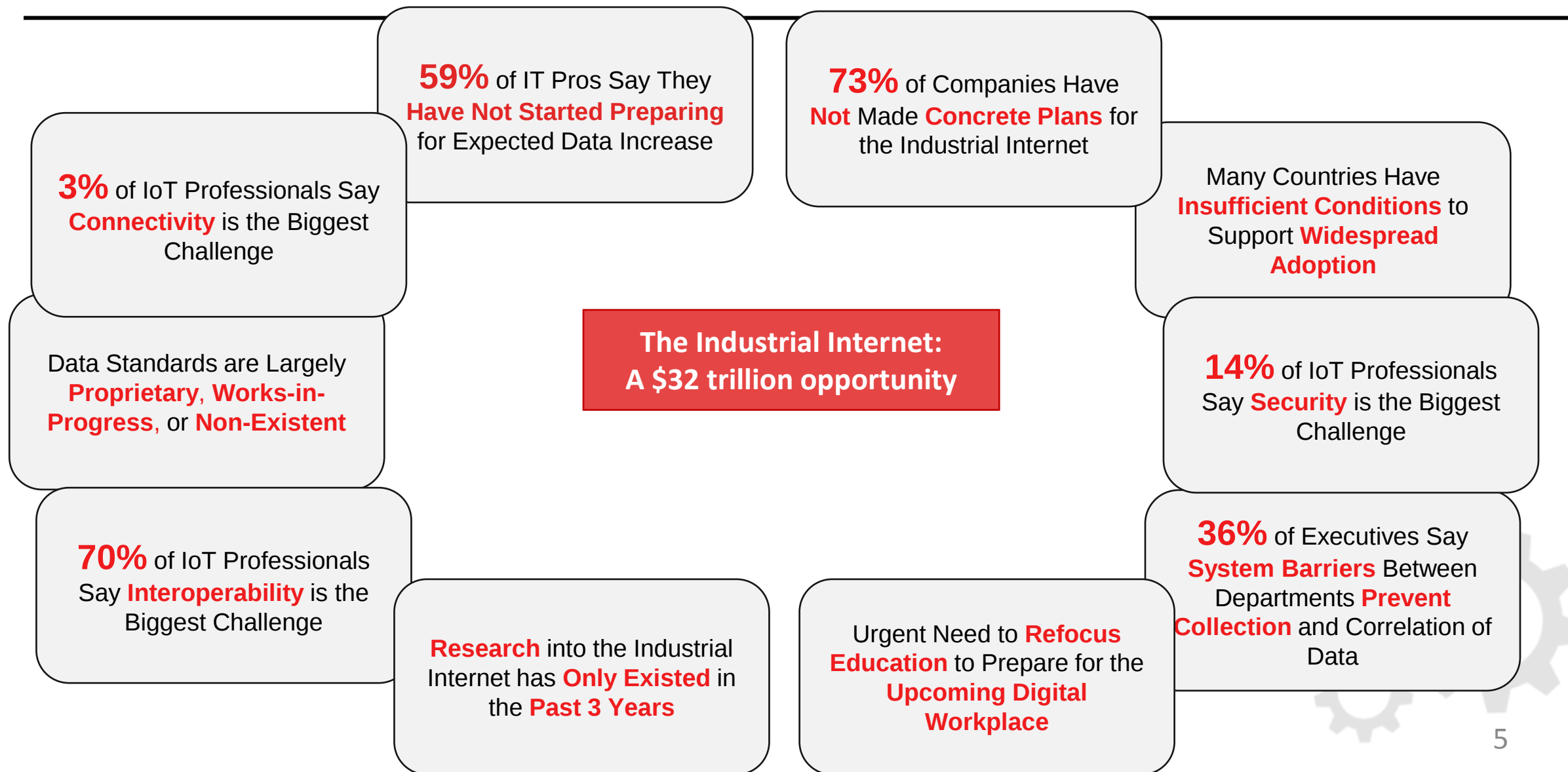


Global GDP Per Capita





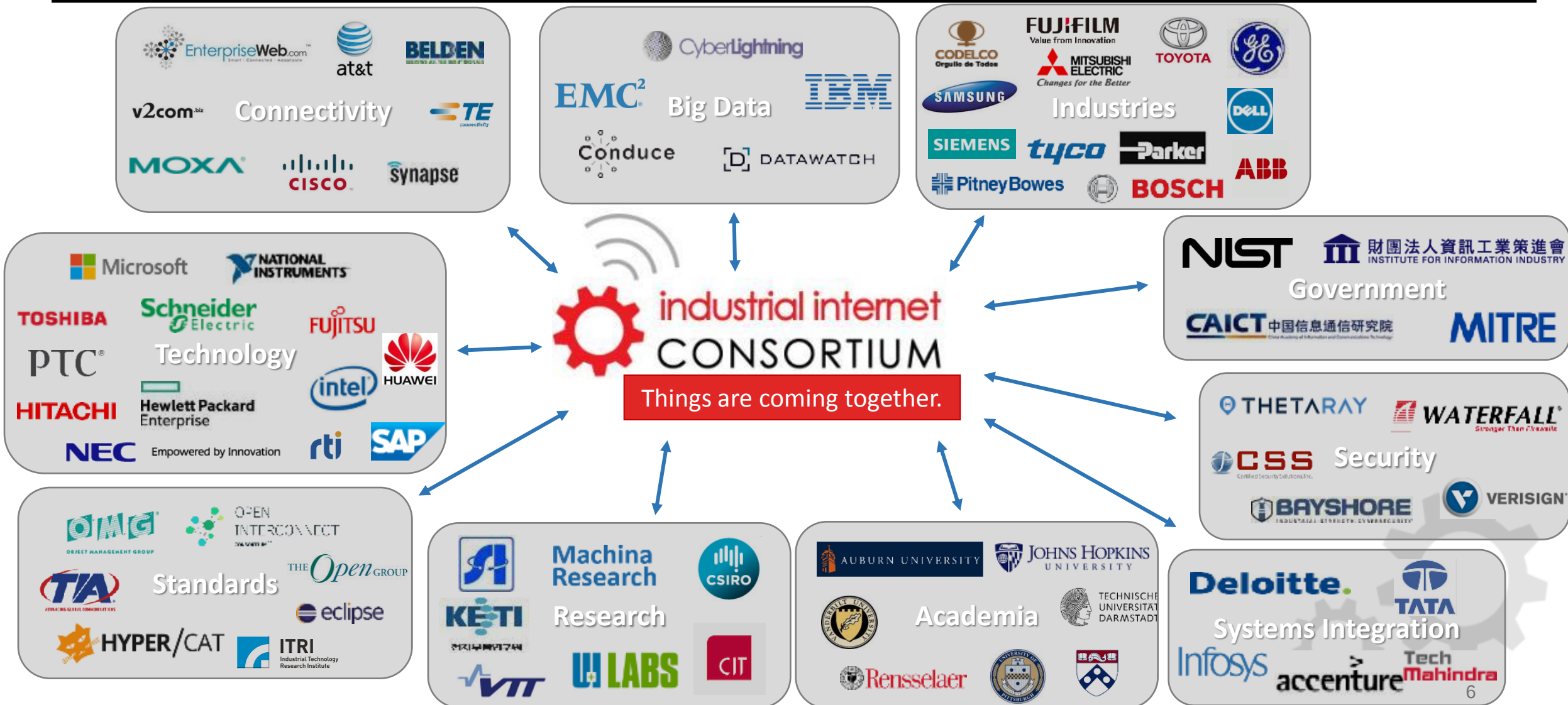
Yet there are current roadblocks to widespread adoption





The IIC Global Ecosystem of Stakeholders:

Things are coming together





Industrial Internet Consortium Vision & Mission



Vision: *The Industrial Internet Consortium (IIC) is the world's leading organization transforming business and society by accelerating the Industrial Internet of Things (IIoT).*

Mission: *Our mission is to deliver a trustworthy Industrial Internet of Things (IIoT) in which the world's systems and devices are securely connected and controlled to deliver transformational outcomes.*

An open, neutral “sandbox” where the IIoT Ecosystem of global industry, academia and government meet to collaborate, innovate and enable.

- More than 250 organizations from more than 30 countries and growing
- 27 active testbeds all over the world from more than a dozen different segments
- Numerous publications including Reference Architecture; Security Framework; Analytics WP

The IIC is an open, neutral “sandbox” where industry, academia and government meet to collaborate, innovate and enable.



IIC Founders, Contributing Members, & Large Industry Members

IIC Founding and Contributing Members



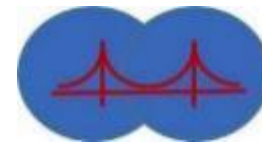
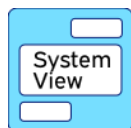
IIC Founders, Contributing Members, & Large Industry Members



IIC Small Industry Members

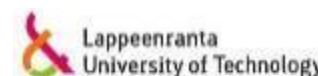


IIC Small Industry Members





IIC Nonprofit, Academic, & Government Members



Business Strategy and Solution Lifecycle



Business Strategy



Solution Lifecycle



Project Toolkit

IIRA

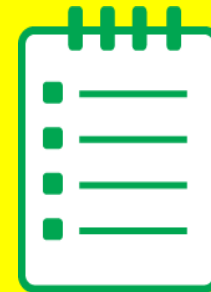
Security Framework



Topics and Themes



Requirements for Standards



Business Model,
Project Mgmt,
Practices



Project
Specifications
& Reports



Architecture
& Design



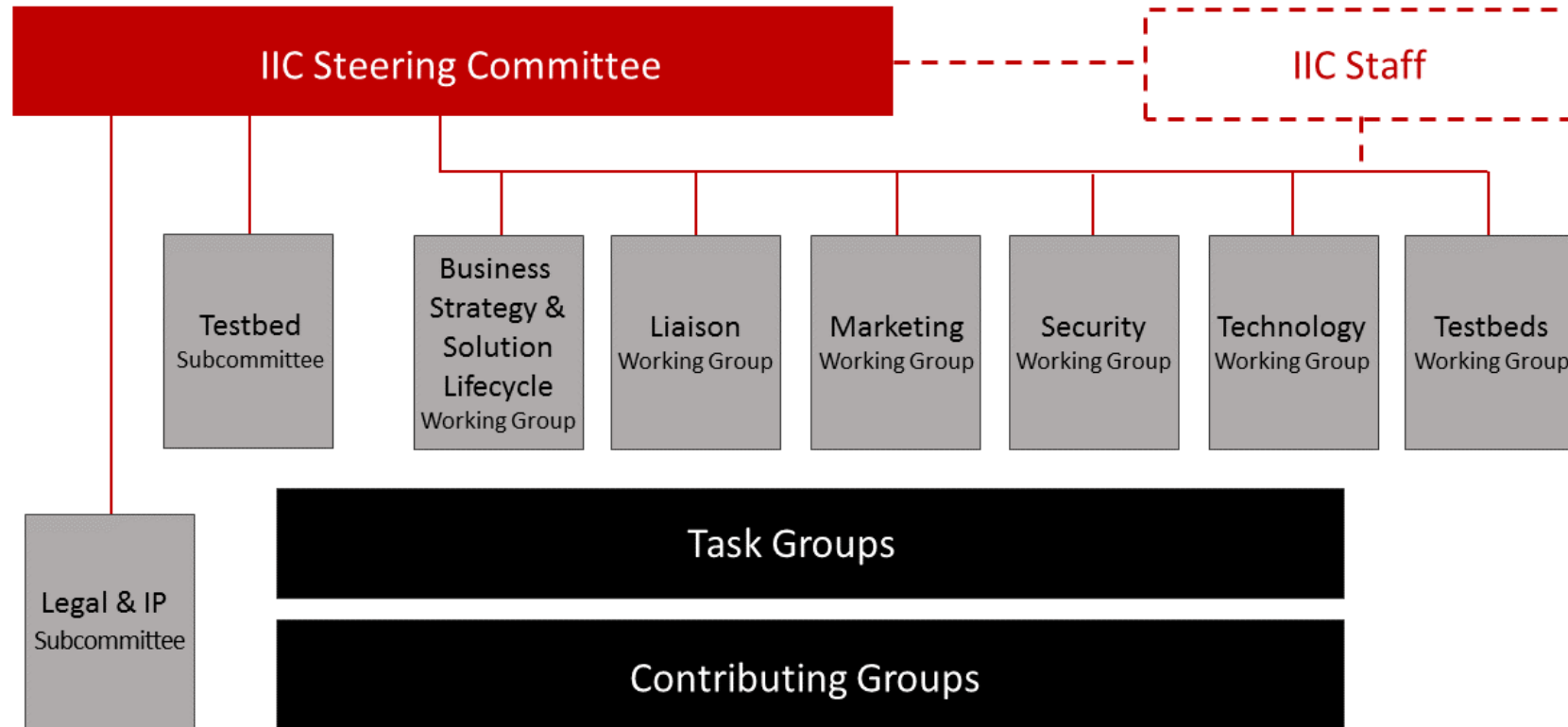
Testbeds
& Projects

IIC

General IIoT Ecosystem



Organizational Structure of the Industrial Internet Consortium



Charter: To define and develop common architectures, by selecting from standards available to all, from open, neutral, international, consensus organizations and reviewing relevant technologies that comprise the ecosystems that will make the industrial internet work.

The Technology WG presently has 12 teams:

- Architecture Task Group
- Reference Architecture Editing Contributing Group
- Connectivity Task Group
- Distributed Data Interoperability & Management Task Group
- Industrial Analytics Task Group
- Edge Computing Task Group
- Innovation Task Group
- IT & OT Task Group
- Interoperability Task Group
- Safety Task Group
- Verticals Taxonomy
- Vocabulary Task Group





Architecture Description for IIC

Built on Top of ISO/IEC/IEEE 42010:2011

Stakeholders



Biz decision makers
System Engineers
Product Managers

Why



System Engineers
Product Managers
System Architects

Verb

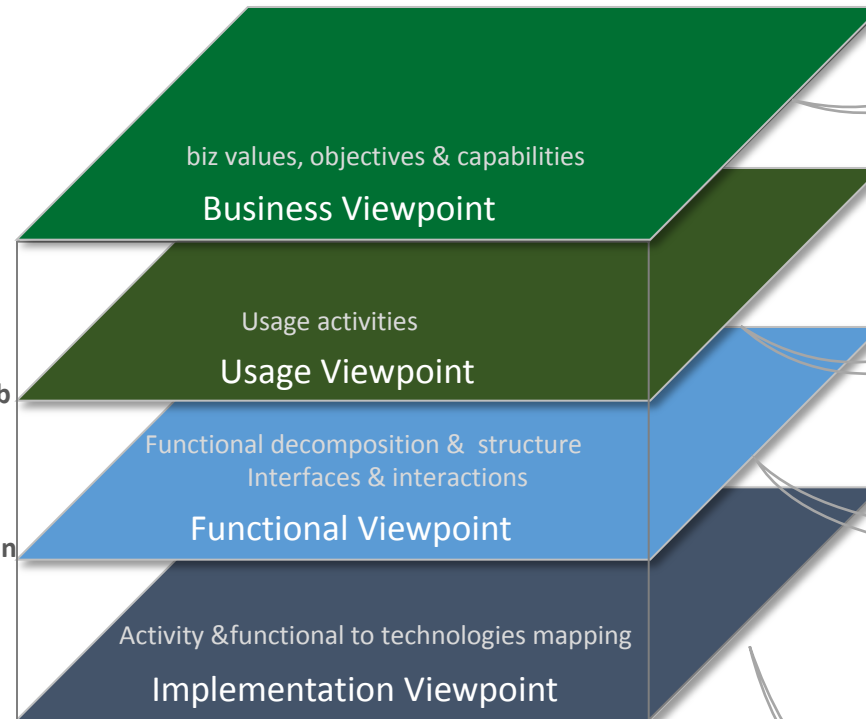
What

Noun



Architects
Engineers
Developers
Integrators
Deployment
Operations

How



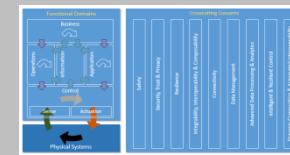
Biz View



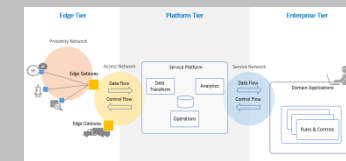
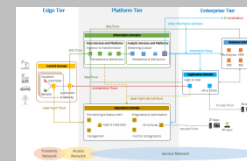
Usage View



Functional View



Implementation View





Security Working Group

Charter: To define a security and privacy framework to be applied to technology adopted by the IIC. The framework will establish best practices and be used to identify security gaps in existing technologies.

Current Priorities:

- Build End-to-End Security Use Cases
 - Apply Security Use Cases to each of the Use Case Groups
 - Derive requirements from each Use Case
- Identify what is common (architectural)
- Identify what is one-off (application-specific)
- Design Secure Integration Framework based on combined use cases (with Technology Team) - [II Security Framework v1.0](#)
[Published September 2016](#)
 - Build testbeds - Testbed Evaluation Documentation





Business Strategy & Solution Lifecycle (BSSL) Working Group

Charter: To provide guidance and best practices for all aspects of developing and operating an Industrial Internet solution: business-case creation, architecture design, technology selection, implementation, testing, rollout and operations.

Goals:

- Help companies leverage the potential of the Industrial Internet
- Increase return on investment, manage project risks more efficiently, and establish a foundation for evaluating solutions and their compliance.
- Provide a foundation for defining Industrial Internet Systems certification and compliance programs, to be shared within and outside of the Industrial Internet Consortium.
- Business Strategy for Industrial Internet of Things Task Group
- Use Cases Task Group, Ecosystem Task Group



The IIoT Ecosystem: Criticality of Liaisons

IIC has more than 28 existing liaisons and currently has 36 more in flight!

That's impressive for an organization that had its 3rd birthday on March 27th, 2017!
Below is a sample of the ecosystem that IIC is creating in the industry





Building Coalitions to Address the IoT Ecosystem

*IIC Vision: The Industrial Internet Consortium (IIC) is the world's leading organization **transforming business and society** by **accelerating** the Industrial Internet of Things (IIoT).*

*IIC Mission: Our mission is to deliver a trustworthy Industrial Internet of Things (IIoT) in which **the world's** systems and devices are securely connected and controlled to deliver **transformational outcomes**.*

LWG Mission: The IIC Liaison Working Group

- *Facilitates **external** interactions with the goal of **building relationships** for IIC*
- *Coordinates internal **stakeholder** requests and interest with external organizations*





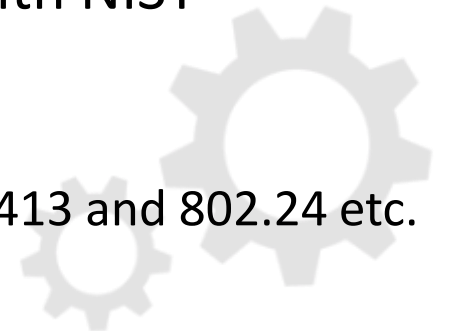
Building Coalitions to Address the IoT Ecosystem

Liaison Working Group *Strategic* Objectives

- **Build** and coordinate **collaborative**, working relationships inclusive of **government** organizations, formal **standards** development organizations and **open source industry** organizations
- Working with peer working groups, identify gaps in the **portfolio** of IIC and create then leverage relationships for IIC
- Make **strategic recommendations** to IIC Steering Committee to grow ecosystem

Example areas of *collaboration*

- **Joint workshops** conducted with partners
 - E.g. IIC:IVI (Japan), IIC:CAICT (China), IIC:I4.0 (Germany), IIC:EEC (Industry)
- **Technical workshops** e.g. recent technology and security workshop with NIST
- Liaison partnerships with organizations focusing on **verticals**
- Liaison partnerships with global **SDOs focused on IoT technologies**
 - E.g. ISO/IEC JTC 1/SC 41 (IoT), ISO/IEC JTC 1/SC 27 (Security), oneM2M, IEEE P2413 and 802.24 etc.
- Liaison partnerships with global **SDOs focused on related areas**
 - E.g. ISO/IEC JTC 1/WG 9 (Big Data)





The IIC is **not** a standards organization.

The IIC will:

- establish a **reference architecture**
- **evaluate** existing standards against it
- **identify requirements**, and
- **propose** these requirements to standards organizations

Requirements are different for the Industrial Internet compared to consumer IoT.





Charter: To establish the Industrial Internet Consortium as a community that champions innovation in connected intelligent machines and processes.

Current Priorities:

- Ensure that the strategy of the IIC is carried out
- Increase market awareness of the Industrial Internet and the IIC
- Create compelling new content around innovation that is happening/innovation to come
- Focus on thought leadership and vertical markets



The Industrial Internet in Action

Norfolk Southern Railroad

Challenge

- Increase capacity by increasing speed and efficiency

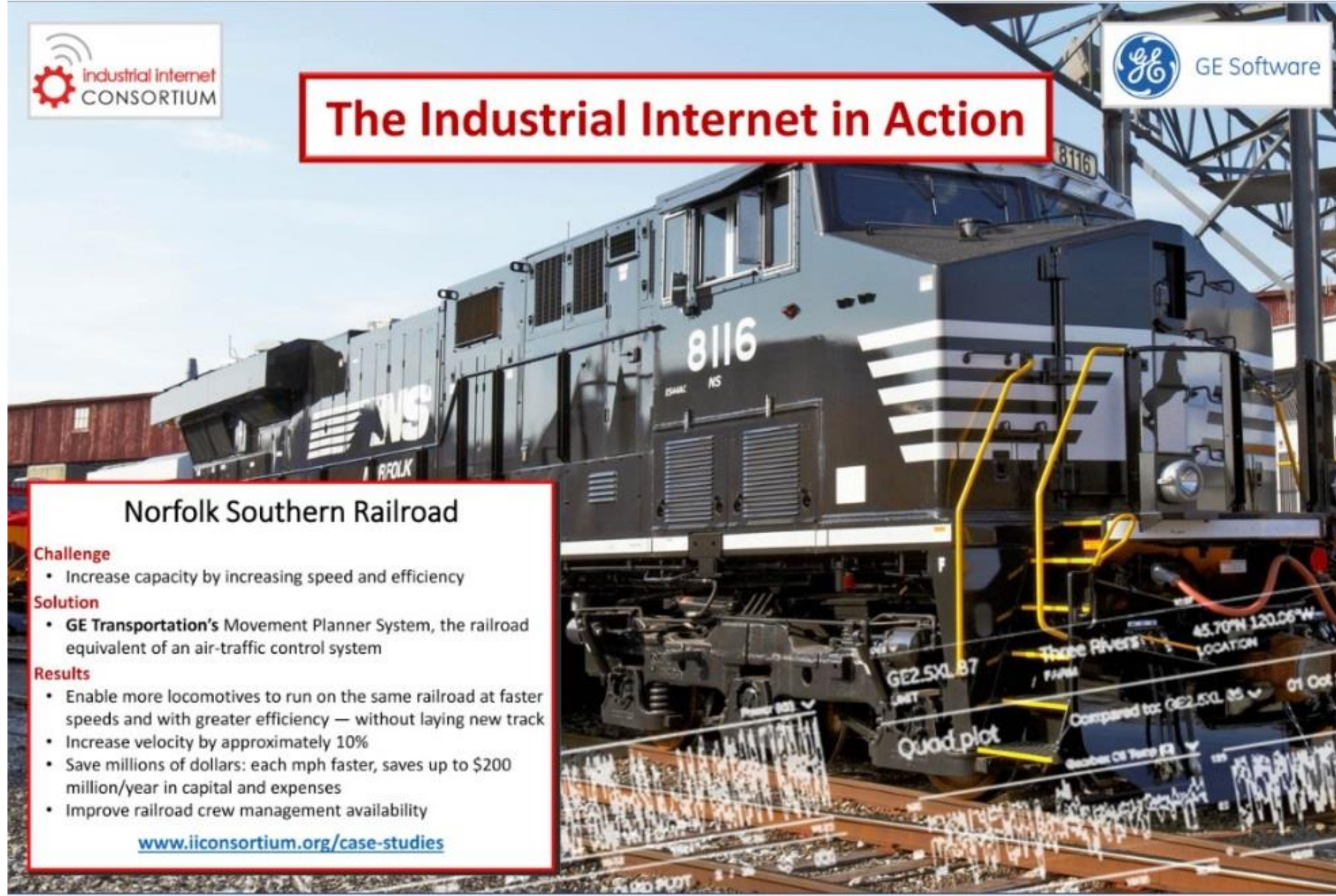
Solution

- **GE Transportation's** Movement Planner System, the railroad equivalent of an air-traffic control system

Results

- Enable more locomotives to run on the same railroad at faster speeds and with greater efficiency — without laying new track
- Increase velocity by approximately 10%
- Save millions of dollars: each mph faster, saves up to \$200 million/year in capital and expenses
- Improve railroad crew management availability

www.iiconsortium.org/case-studies



The Industrial Internet in Action

BK Medical

Challenge

- Scale large distributed ultrasound systems while maintaining or enhancing performance and reliability
- Provide greater integration into the patient care systems for improved decision making for medical staff
- Deliver architectural approach that meets both system and developer needs

Solution

- RTI's Connex[®] DDS - foundation for the BK Medical Global Data Bus
- Data-centric design approach that includes management tools for performance, reliability and other system attributes
- Solution that ensures loose-coupling between system elements

Results

- Implement plug and play, and assess proprietary and commercial hardware architectures
- Provide real-time response and action in a distributed system
- Integrate real-time communications with IT infrastructure
- Add RTI Connex Secure easily to any legacy system

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The Industrial Internet in Action

Marathon Petroleum Company

Challenge

- Reinforce safe work practices and support employee safety

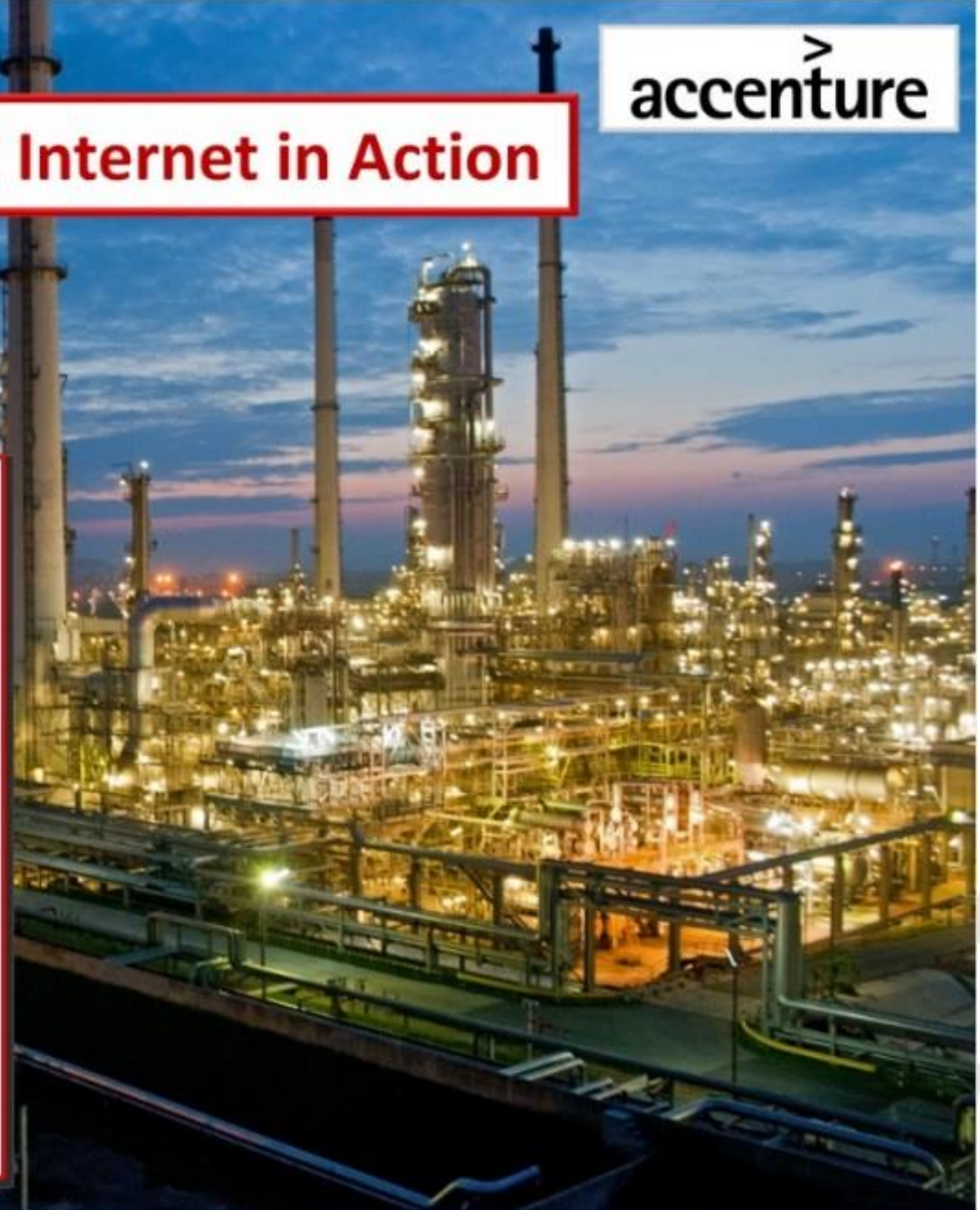
Solution

- **Accenture** Life Safety Solution tracks employees' location in a plant, warns the individual and the plant operators of any potential nearby danger including abnormal gas levels. It can also detect employees' lack of motion ("man down") and trigger the appropriate safety protocol.
- Automatically record any safety incident to allow the plant to continuously improve their safety operational process, and in the case of evacuation, identify any missing individual in a timely manner.

Results

- 24/7 safety monitoring and timely responses to gas leaks
- Greater and more accurate safety incident reporting
- Improved compliance through personnel location monitoring

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The Industrial Internet in Action

Secure Access to Robots

Challenge

- Eliminate VPN access to ensure more secure troubleshooting of factory automation equipment
- Maintain high standards of access control

Solution

- Joint **Bayshore Networks-Cisco** solution enabling secure "line of sight" access for remote users

Results

- Uninterrupted enforcement of secure IT/OT operations and safety policies
- Faster execution of diagnostics and maintenance, without travel
- Zero downtime and higher availability of production zone operations

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The Industrial Internet in Action

Intermodal Container Tracking

Challenge

- Improve inventory management of intermodal containers moving around the globe
- Improve capacity planning

Solution

- **AT&T** GPS location monitoring tracks shipments as they move from major ports worldwide

Results

- Improved theft prevention
- Risk management and mitigation
- Efficient auditing

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The Industrial Internet in Action

Intel Manufacturing

Challenge

- Increase operational efficiency and reduce maintenance costs in an Intel factory
- Extract value from a wide variety of manufacturing data

Solution

- With industry collaboration from Cloudera, Dell, Mitsubishi Electric, and Revolution Analytics, **Intel** manufacturing developed and deployed an IoT and big data analytics solution

Results

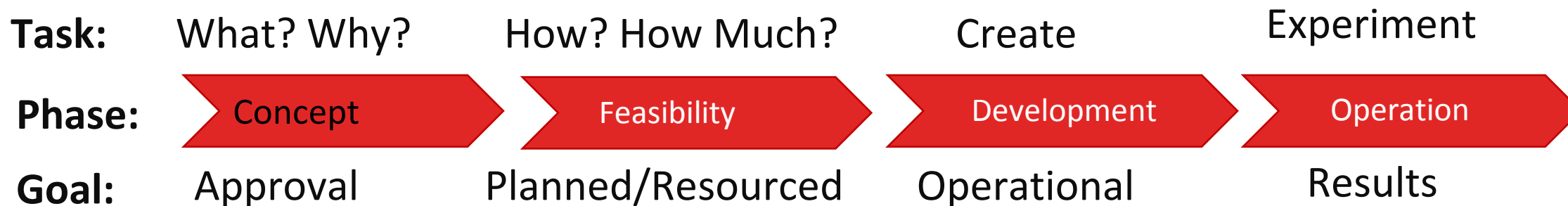
- Save millions of dollars annually
- Improve yields by addressing manufacturing tool issues in advance
- Boost efficiency, including a one-tenth reduction in test times
- Reduce downtime by identifying worn tool parts prior to planned maintenance

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Charter: To accelerate the creation of testbeds for the Industrial Internet.

Testbed Lifecycle Phases

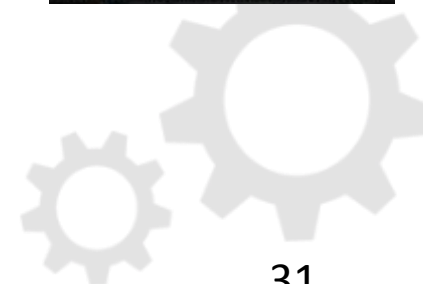


Current Priorities:

- Assist members in identifying, defining and gaining approval for their testbeds
- Identify and communicate funding resources for IIC testbeds
- Provide processes and infrastructure for efficient & effective operations



Current Publicly Announced Testbeds





What is an IIC Testbed?

CONTROLLED EXPERIMENTATION PLATFORM

*~conforming to an IIC technical references,
where solutions can be deployed and tested in
environments resembling real-world conditions*

Explore untested technologies or existing technologies
working together in an untested manner

Create innovative new products, services, and business practices

Generate requirements and priorities for standards organizations

Business Model,
Project Mgmt,
Practices



Project
Specifications
& Reports



Architecture
& Design



Testbeds
& Projects



Testbed Results

Innovation

- What innovations have been realized? Any industry impact?
- What best practices have been learned

Standards

- What noteworthy standards does the testbed employ? Their purpose?
- What noteworthy standards is the testbed influencing? Which SDOs?
- What gaps have been identified that should become a future standard?

Technical References

- What changes would you like to see in IIC Technical References?
- What influence has the testbed had on IIC Technical References?





Agenda

Overview of IIC

Industrial Analytics Task Group: Overview and Motivation

Industrial Analytics Framework (IIAF)

Looking Ahead: What's on the Horizon for Industrial Analytics

Concluding Remarks





Industrial Analytics is Part of the Technology Working Group

Charter: To define and develop common architectures, by selecting from standards available to all, from open, neutral, international, consensus organizations and reviewing relevant technologies that comprise the ecosystems that will make the industrial internet work.

Chairs: Diab (Huawei), Harper (ABB), Lin (Thingswise)

The Technology WG presently has 11 standing task groups:

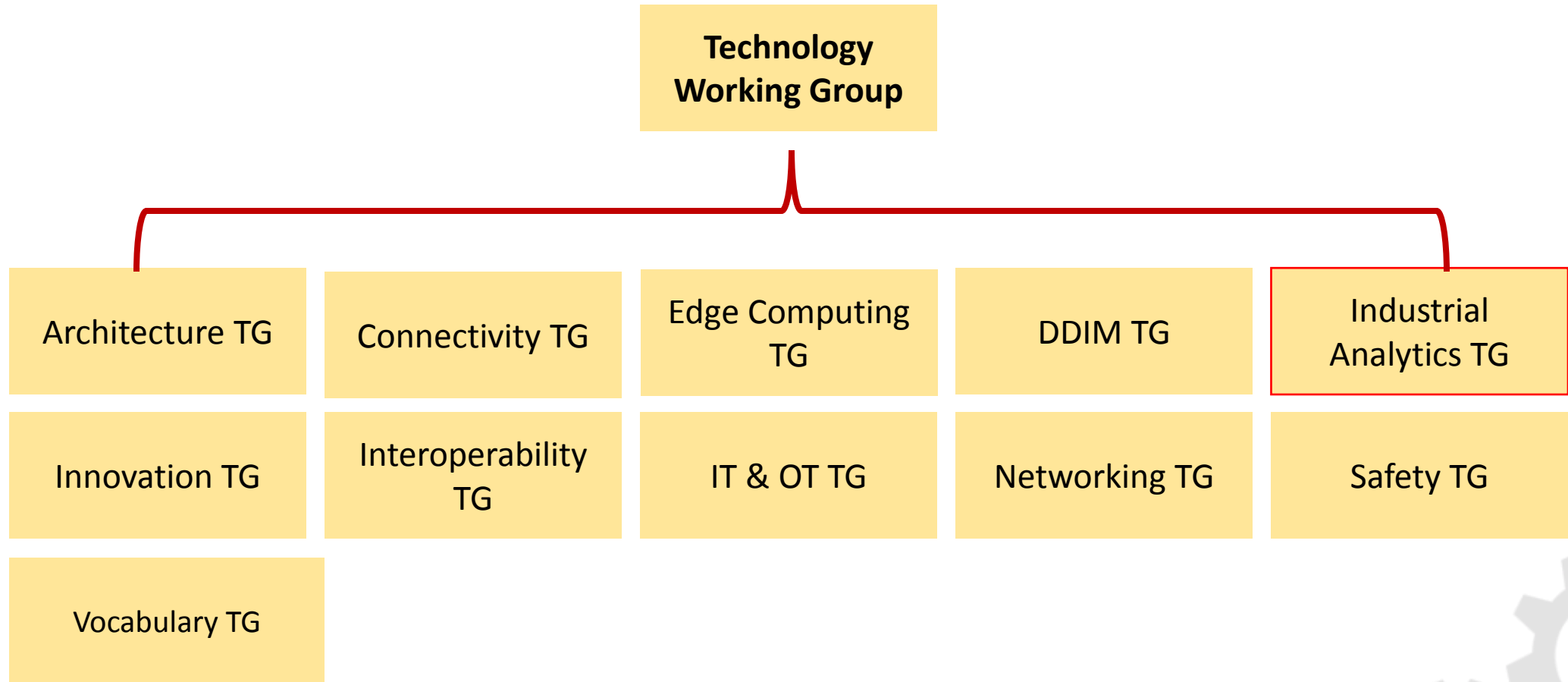
- Architecture Task Group
- Connectivity Task Group
- Distributed Data Interoperability & Management Task Group
- Edge Computing Task Group
- **Industrial Analytics Task Group**
- Innovation Task Group
- Interoperability Task Group
- IT & OT Task Group
- Networking Task Group
- Safety Task Group
- Vocabulary Task Group

And a number of contributing groups





Technology Working Group Organization





Industrial Analytics Task Group

Who We Are and What We Do?

Mission

The IA Task Group is responsible for comprehensibly defining the properties of realizable analytical techniques and methods for deriving meaning from, and adding value to, industrial systems.

Scope

To achieve its mission, the task group:

- Will deliver a technical report detailing capabilities, requirements, existing and new open standards, and technologies presented in an Industrial Internet Analytics Framework
- Influence / drive requirements in other IIC teams and working groups
- Catalog various technology choices for analytics
- Analytics on both data in motion and at rest
- Hierarchical and distributed considerations of industrial analytics
- Data integrity interactions for analytics
- Analytics for safety and security of operation

Chairs: Diab, Wael William (Huawei), Harper, Eric (ABB), Sobel, Will (System Insights)

Membership: 120 members from 60 organizations represented per Kavi as of 11-06-2017





Industrial Analytics Task Group

Work and Deliverables Landscape

Initial deliverables are a White Paper and Industrial Internet Analytics Framework

Group's target schedule is

- Q1 2017 for White Paper ← **Completed 0317**
- Q3 2017 for first release of Framework ← **Completed 1017**
- Q2 2018 for second release of Framework ← **Initial exploratory phase**

Internal stakeholder for liaison relationships

- E.g. ISO/IEC JTC 1/WG 9 (Big Data), MESA

Membership engagement Initiatives

- Invited speakers
- Host Industrial Analytics panels (session and plenary)

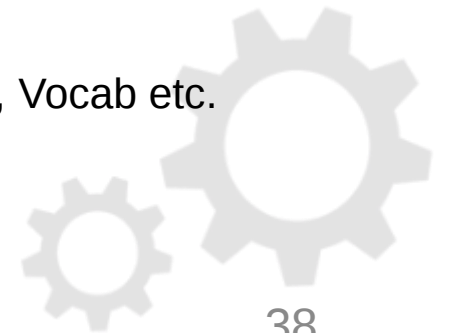
Represent IIC IA topics at liaison partner events and external engagements

- Big Data workshop (JTC 1/WG 9 in Ireland), analyst/reporter calls and *today!*

Coordinate industrial analytics interests within Technology Working Group family e.g. Edge, Safety, Vocab etc.

Collaborate with internal stakeholders outside of TWG e.g. I3C, LWG, BSSL, Marketing etc.

Identify and work on cross-cutting issues related to analytics



IIC Industrial Analytics General Session Expert Panel (Dec 16)

- Participants
 - Wael Diab (Huawei) Co-Chair / Moderator
 - Eric Harper (ABB) Co-Chair
 - Nilesh Auti (TechMahindra) Panelist
 - Terrence Barr (Electric Imp) Panelist
 - Brent Hodges (Dell) Panelist
 - Shi-Wan Lin (Thingswise) Panelist
 - Shyam Nath (GE) Panelist
 - Sven Schrecker (Intel) Panelist
 - About 70+ in the audience
- Topics included
 - Overview of Analytics in the ecosystem
 - Tiered analytics
 - Technical challenges and opportunities for analytics
 - Safeguards in the system design
 - Use cases and vertical examples
 - Smart security for analytics



5TH INTERNATIONAL WORKSHOP ON BIG DATA 14-AUG-2017

AGENDA

08:30 - 09:15 Coffee + Registration
09:15 - 09:30 Welcome
Ray Walshe CHAIR of IWBD
Enda McDonnell, Director of
09:30 - 09:45 Official Opening
Adrienne Harrington
 Head of Data Protection Unit
 Irish Government Dept. of a
09:45 - 10:00 Special Guest
Daniele Rizzi - EC DG CNEC
 European Standardisation B

Session 1

10:00 - 10:25 **Wo Chang** - ISO IEC JTC1 W
 ISO Big Data Reference Arch
10:30 - 10:55 **Wael Diab** - HUAWEI / IIC /
 Big Data Ecosystem

11:00 - 11:30 Coffee and Networking

Session 2

11:30 - 11:55 **Ashok Ganesh** - CEN CENELEC
 Future Industry Standardisation
12:00 - 12:30 **Arne J Berre** - TF6 LEAD BDVA
 BDVA Standardisation

12:30 - 13:30 LUNCH

Session 3

13:30 - 13:55 **Rigo Wenning** - W3C
 Big Data Europe -Data Engine
14:00 - 14:25 **Ingo Simonis** - OPEN GEOSPATION CONSORTIUM
 Standardized Geospatial Big Data
14:30 - 14:55 **Georgios Karagiannis** - AIOTI
 WG3 AIOTI Standardisation
15:00 - 15:30 Panel Session
Ray Walshe (Insight@DCU)
Daniele Rizzi (European Commission)
Wo Chang (NIST / IEEE-SA)
Ana Garcia (Big Data Value Association)
Thomas Hahn (OPC Foundation)

15:30 - 15:45 Final Remarks

15:45 - 16:30 **Close of Workshop and Networking**



5TH INTERNATIONAL WORKSHOP ON BIG DATA DUBLIN IRELAND 14TH AUG 2017



Adrienne Harrington
 Dept. of Taoiseach (IRLGOV)
 Head of Data Protection Unit



Daniele Rizzi
 European Commission
 Data Policy and Innovation



Ray Walshe
 IEEE-SA/BDVA/ ISO
 Chair of BDVA TF6SG6



Ana Garcia
 Big Data Value Assoc.
 BDVA Secretary General



Thomas Hahn
 OPC Foundation
 Board member



Ashok Ganesh
 CEN CENELEC
 Director Innovation



Arne J Berre
 Big Data Value Assoc
 TF6 Technical Task Force



Georgios Karagiannis
 AIOTI
 Lead WG3 Standardisation



Wael William Diab
 Huawei / IIC / ISO TC204
 Sr. Director / Chair IIC Liaison WG



Rigo Wenning
 W3C
 Personal Data Expert



Wo Chang
 NIST / IEEE-SA
 ISO IEC WG9 Big Data



Ingo Simonis
 Open Geospatial Consortium
 Director Innovation



<https://iwbd17.eventbrite.ie>
 to reserve a FREE Ticket

International data analysis workshop (5th JUNE, 2017)

10 speakers, About 200 participants from 100+ entities, in CAICT, Beijing





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Looking Ahead: What's on the Horizon for Industrial Analytics

Concluding Remarks





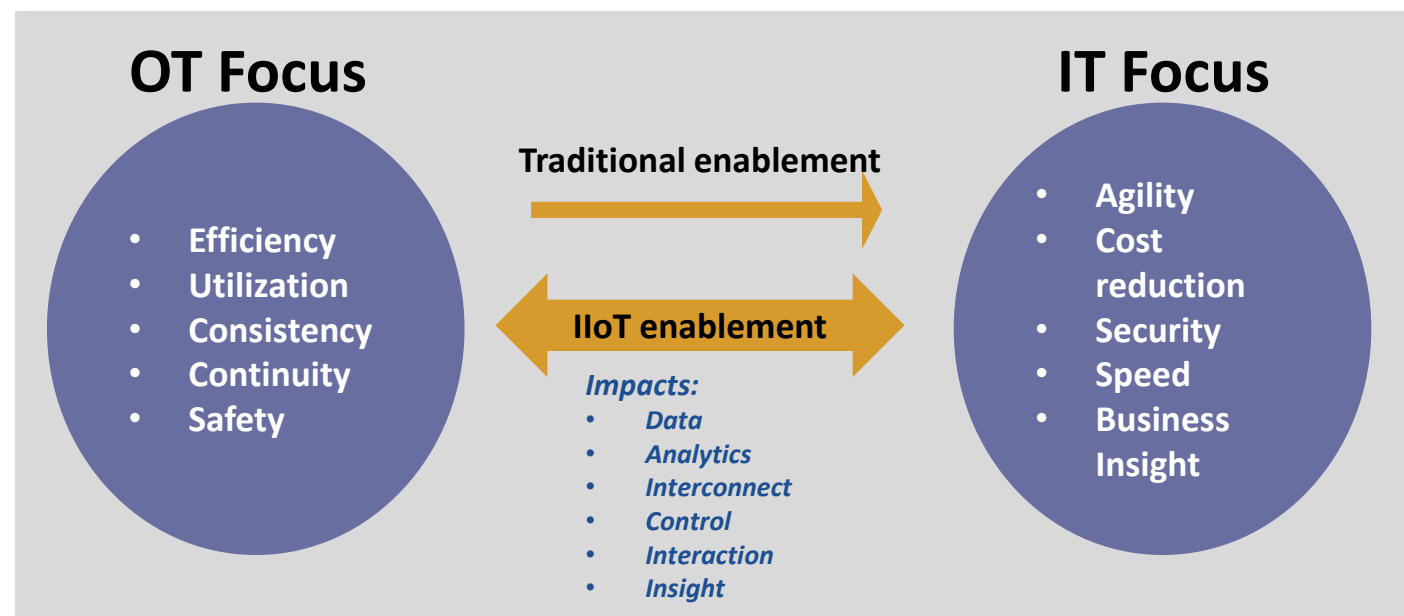
Introducing IIAF

- This presentation provides an overview of the Industrial IoT Analytics Framework (IIAF)
- Is a first-of-its-kind blueprint that addresses the entire industrial analytics ecosystem
- The target audience is IIoT decision makers, such as system architects / designers and business leaders, looking to successfully deploy industrial analytics systems
- Provides information about concepts and components of the IIoT system, which architects require to develop and deploy a viable analytical system in an industrial setting
- Takes into account industrial requirements, goals and cross-cutting concerns. Maps analytics to the supported IIoT applications, ensuring that business leaders can realize the full potential of analytics and thus enable more-informed decision making

Industrial Analytics: The engine driving the emerging IT/OT revolution

MAIN TOPICS

- Framework overview
- Business View Point
 - Creating Business Value
- Usage View Point
 - Getting started with Industrial Analytics
- Functional View Point
- Implementation View Point
 - Design considerations
- AI and Big Data
- Analytic Methods & Modelling
- System Characteristics and Crosscutting Functions Related to Analytics





Industrial IoT Analytics Framework Overview

Provides guidance and assistance in the development, documentation, communication and deployment of Industrial Internet of Things Analytics Systems.

The IIAF does this by taking a holistic view of the entire industrial IoT ecosystem that the analytics is operating in. A number of view points are considered along with emerging technologies in this space and cross-cutting concerns:

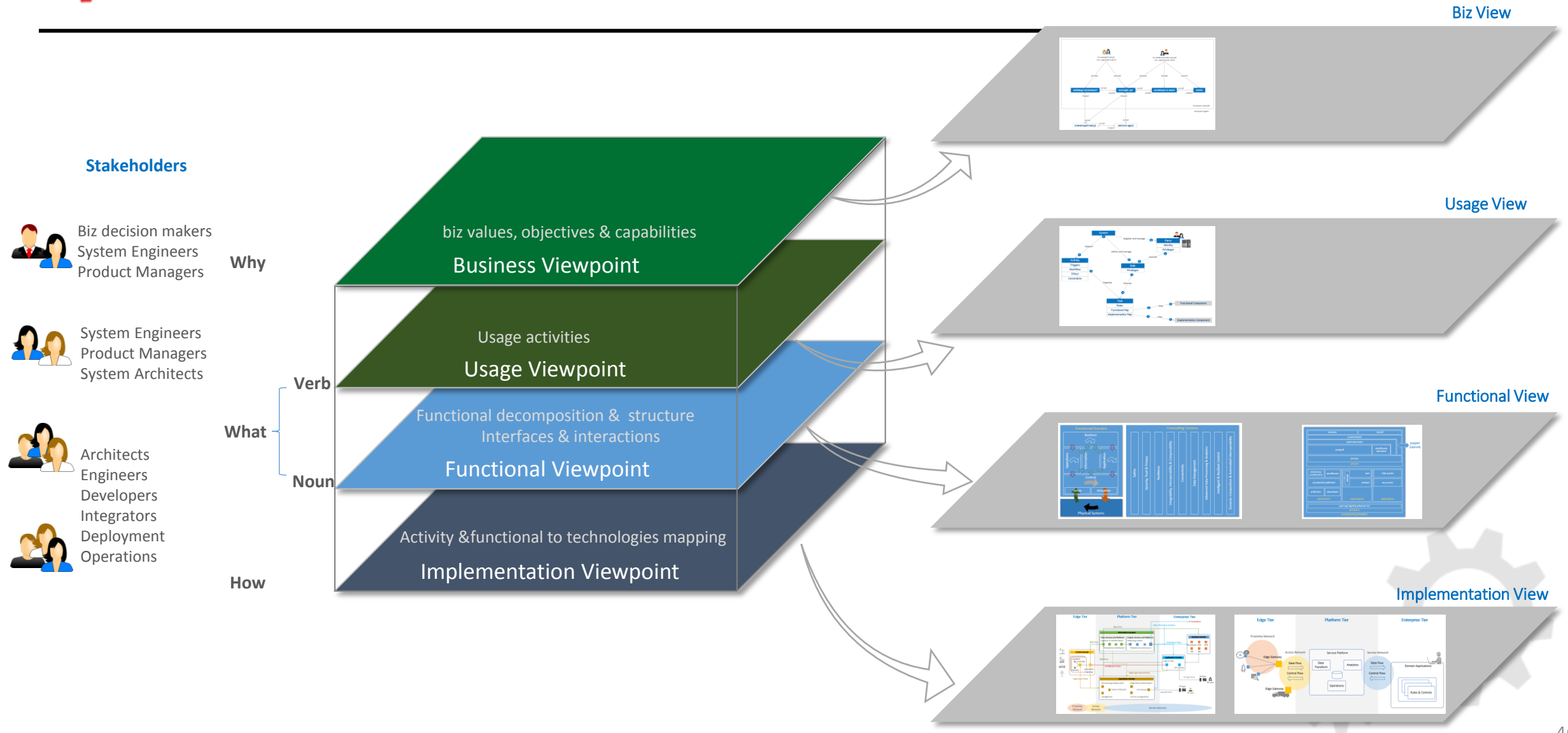
- Business viewpoint
 - E.g. Creation of Business Value
- Usage View Point
 - E.g. Getting started with Industrial Analytics
- Functional View Point
 - E.g. Analytics Architecture Objectives and Constraints
 - E.g. Analytics Functionality
- Implementation View Point
 - E.g. Design considerations
 - E.g. Analytics Capacity Consideration
- Artificial Intelligence (AI) and Big Data
- Analytic Methods & Modelling
- System Characteristics and Crosscutting Functions Related to Analytics

“Analytics may be broadly defined as a discipline transforming data into information through systematic analysis. Industrial Analytics is the use of analytics in IIoT systems.”

“Within the Industrial space, the merger of IT and OT is providing for innovation and creating disciplines such as condition monitoring to increase uptime and reduce operational costs (OpEx)”

“If data is the new oil, data analytics is the new engine that propels the IIoT transformation.”

IIAF Architectural Description Built on ISO/IEC/IEEE 42010:2011





Business View Point – Creating Business Value

“ Industrial analytics, applied to machine data for operational insights, is as an engine driving the convergence of OT and IT, and ultimately value creation for the Fourth Industrial Revolution. ”

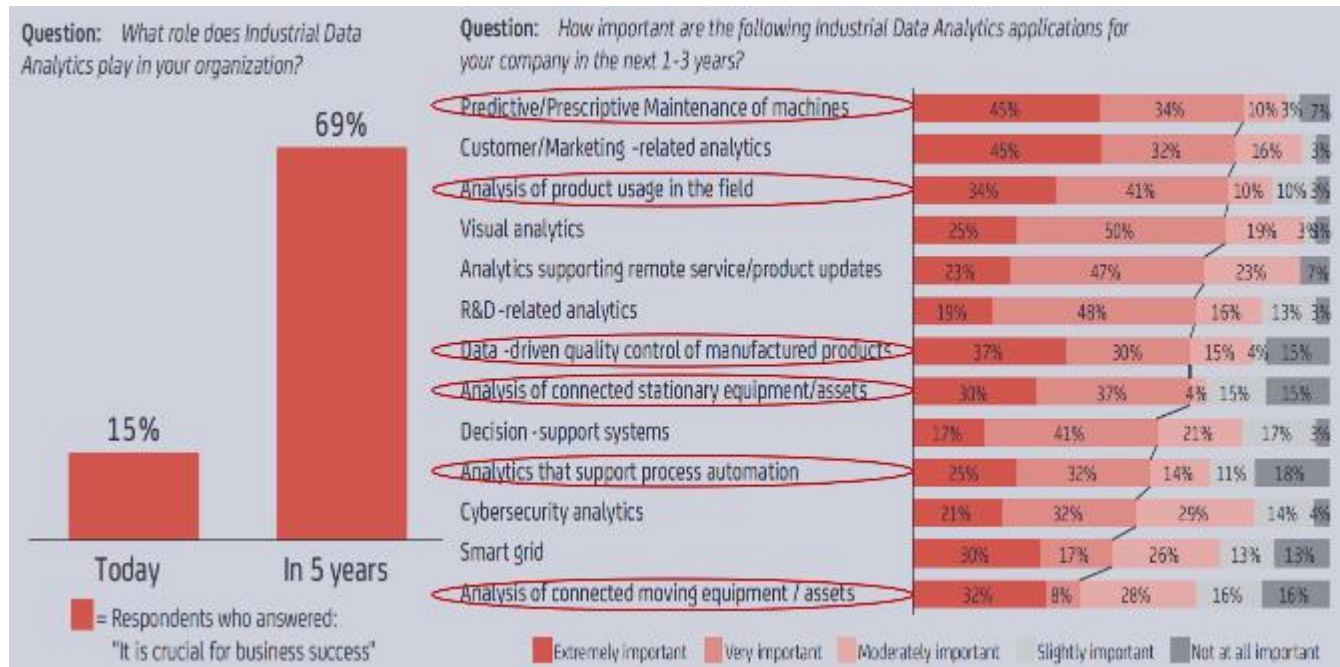
What is it? Attends to concerns of the identification of stakeholders and their business vision, values and objectives in establishing an industrial analytics system in its business and regulatory context

Why is it Important? IA provides crucial insights for decision makers, which in turn translate to an increase in the efficiency of labor and capital, which determine long-term GDP growth

A survey by Deloitte shows predictive analytics to be at the top of the list

Advanced Manufacturing Technologies	US	China	Europe
Predictive analytics	1	1	4
Smart, connected products (IoT)	2	7	2
Advanced materials	3	4	5
Smart factories (IoT)	4	2	1
Digital design, simulation, and integration	5	5	3
High performance computing	6	3	7
Advanced robotics	7	8	6
Additive manufacturing (3D printing)	8	11	9
Open-source design/Direct customer input	9	10	10
Augmented reality (to improve quality, training, expert knowledge)	10	6	8
Augmented reality (to increase customer service & experience)	11	9	11

A survey by IoT Analytics GmbH found 69% of business leaders consider industrial analytics crucial for their businesses within 5 years





Usage View Point – Getting Started with Industrial Analytics

What is it? Addresses the concerns of expected system usage.

“Industrial analytics are used to identify and recognize machine operational and behavioral patterns, make fast and accurate predictions and act with confidence at the points of decision”

Analytics fall into 3 areas:

- **Descriptive**
- **Predictive**
- **Prescriptive**

The framework introduces unique requirements when planning to deploy industrial analytics

<i>Correctness</i>	Industrial Analytics must satisfy a higher level of accuracy in its analytic results. Any system that interprets and acts on the results must have safeguards against undesirable and unintended physical consequence.
<i>Timing</i>	Industrial Analytics must satisfy certain hard deadline and synchronization requirements. Near instantaneous analytic results delivered within a deterministic time window are required for reliable and high quality actions in industrial operations.
<i>Safety</i>	When applying Industrial Analytics, and interpreting and acting on the result, strong safety requirements must be in place safeguarding the wellbeing of the workers, users and the environment.
<i>Contextualized</i>	The analysis of data within an industrial system is never done without the context in which the activity and observations occur. One cannot construct meaning unless a full understanding of the process that is being executed and the states of all the equipment and its peripherals are considered to derive the true meaning of the data and create actionable information.
<i>Causal-oriented</i>	Industrial operations deal with the physical world and Industrial Analytics needs to be validated with domain-specific subject matter expertise to model the complex and causal relationships in the data. The

Functional View Point – Architecture Objectives and Constraints

What is it? focuses on the functional components in an industrial analytics system, their structure and interrelations and the relation and interactions of the system with external elements, to support the usages and activities of the overall system.

An end-to-end IIoT system in the IIRA is functionally decomposed into five functional domains:

- **Control**
- **Operations**
- **Information**
- **Application**
- **Business**

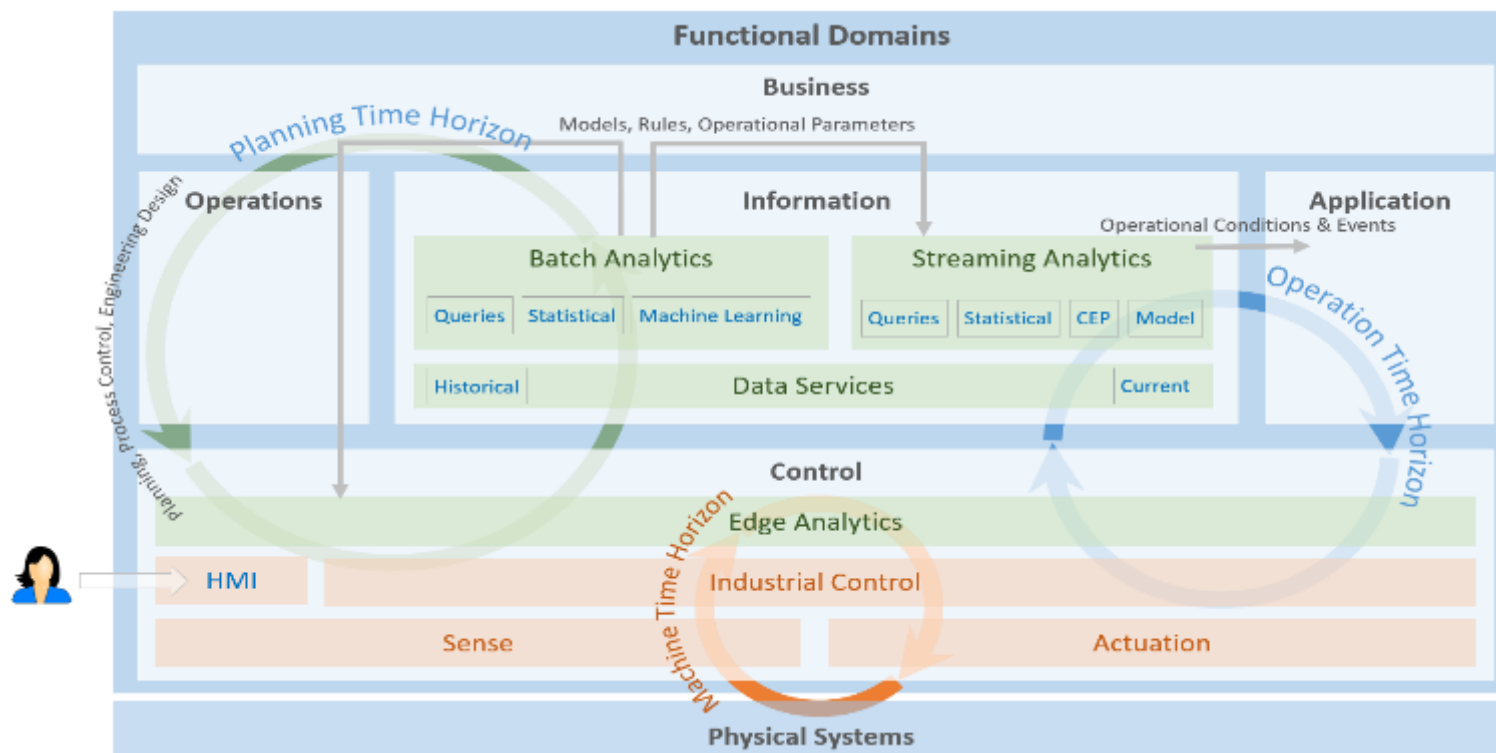


Figure 4-1. Analytics Mapping to the Industrial Internet Reference Architecture



Implementation View Point – Design Considerations

What is it? Deals with the technologies needed to implement functional components (functional viewpoint), their communication schemes and their lifecycle procedures. Major sections include design and capacity considerations as well as deployment models and data preprocessing, transformation and curation. Below is an example of design considerations

“One of the common questions is ***where*** the analytics should be performed.”

Considerations such as **scope, response time and reliability, bandwidth, capacity, security, volume, velocity, variety, analytics maturity, temporal correlation, provenance, compliance** etc. determine where the analytics run.

The framework introduces a table with these factors

Industrial Analytics Location

<i>Evaluation Criteria</i>	<i>Plant</i>	<i>Enterprise</i>	<i>Cloud</i>
<i>Analysis Scope</i>			
<i>Single site optimization</i>	X	X	X
<i>Multi-site comparison</i>		X	X
<i>Multi-customer benchmarking</i>			X
<i>Results Response Time</i>			
<i>Control loop</i>	X		
<i>Human decision</i>	X	X	
<i>Planning horizon</i>	X	X	X
<i>Connectivity Reliability</i>			
<i>Site</i>	X		
<i>Organization</i>	X	X	



Emerging Technologies – Artificial Intelligence and Big Data

What is it? Innovations in a number of areas related to AI and Big Data are being applied to IA. The framework looks at taxonomies of artificial intelligence and emerging computational techniques in big data in relation to industrial analytics.

“ In IIoT applications, machine learning and deep learning provide new approaches to build complex models of a system or systems using a data-driven approach. ”

“ Big data requires computational systems and networks to be designed around the data. It will transform how businesses operate and the digital/physical divide. ”



Figure 6-2 Artificial Intelligence (AI)

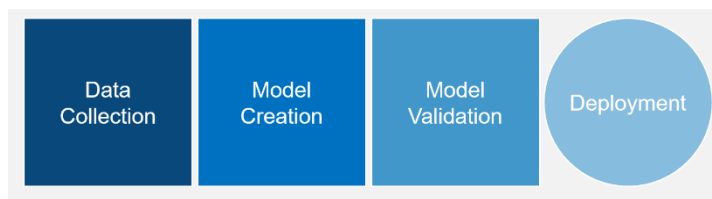
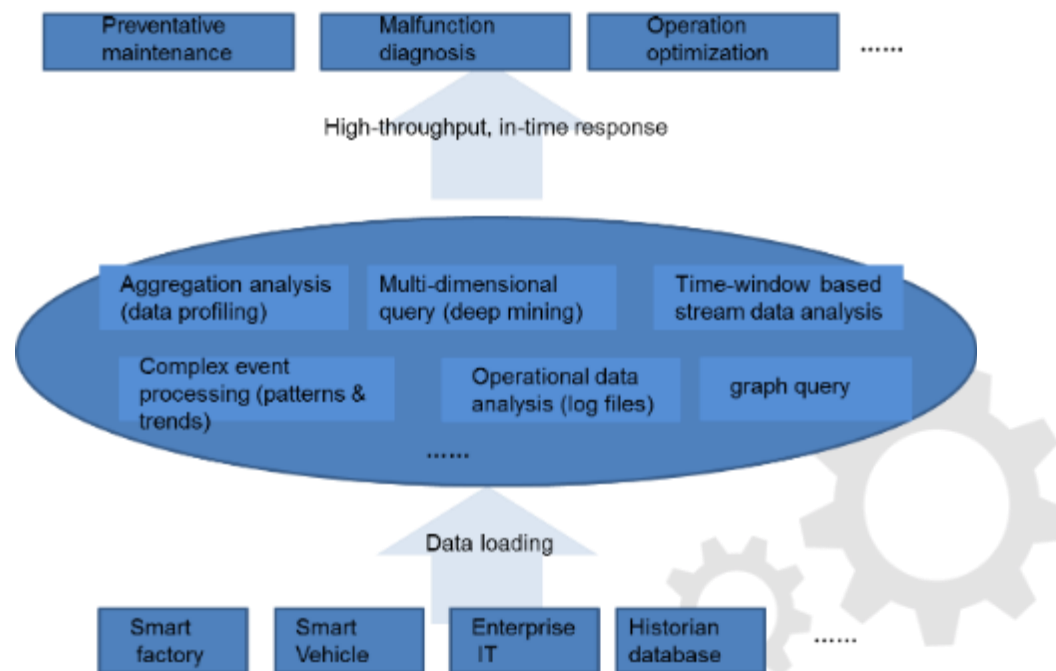


Figure 6-8 Deep learning workflow



Example of Multi-Typed Data Processing in Big Data Analytic Systems



Analytics Methods and Modelling – Model Building

What is it? Survey of methods, models, algorithms and frameworks used for industrial analytics applications.

Algorithms		
Anomaly Detection (Baseline)	Classification (Diagnostic)	Regression (Predictive)
One-Class SVM	Neural Networks	ARMA
PCA-based	Support Vector Machine	Linear Regression
Gaussian Mixture Model (GMM)	Decision Forest	NN Regression
Logistic Regression	Bayes Classifier	Bayes Regression

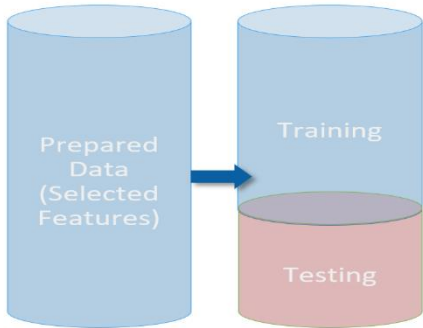


Figure 7-5 Splitting data for cross validation

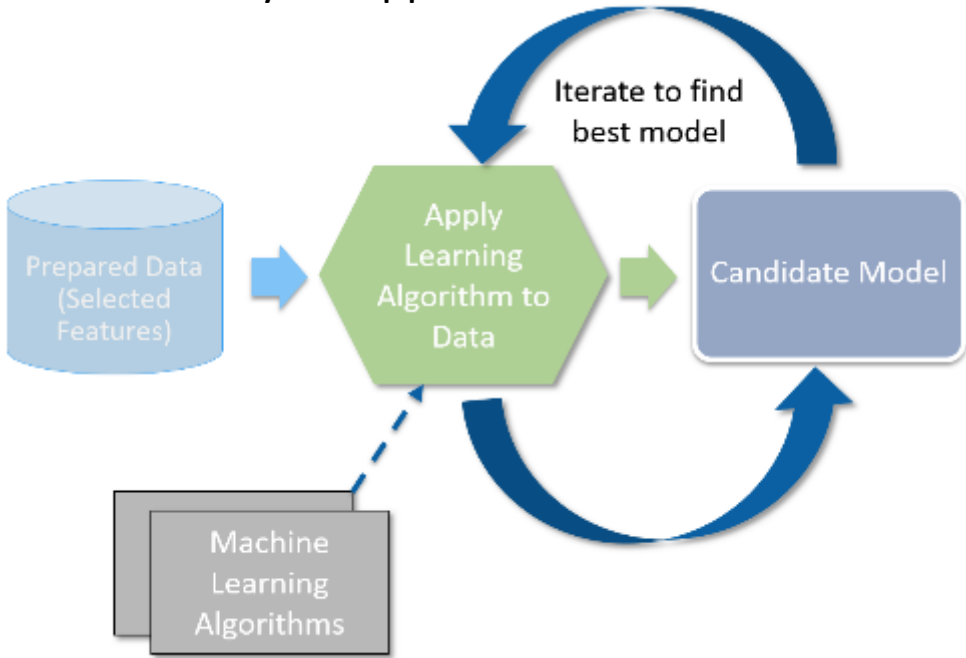


Figure 7-4 The model building process

		Predicted Condition	
		Predicted Condition Negative	Predicted Condition Positive
True Condition	Condition Negative	True Negative	False Positive (Type I Error)
	Condition Positive	False Negative (Type II Error)	True Positive

Figure 7-6 Confusion matrix showing types of classification errors for a binary classification problem



Relationship with other IIC documents

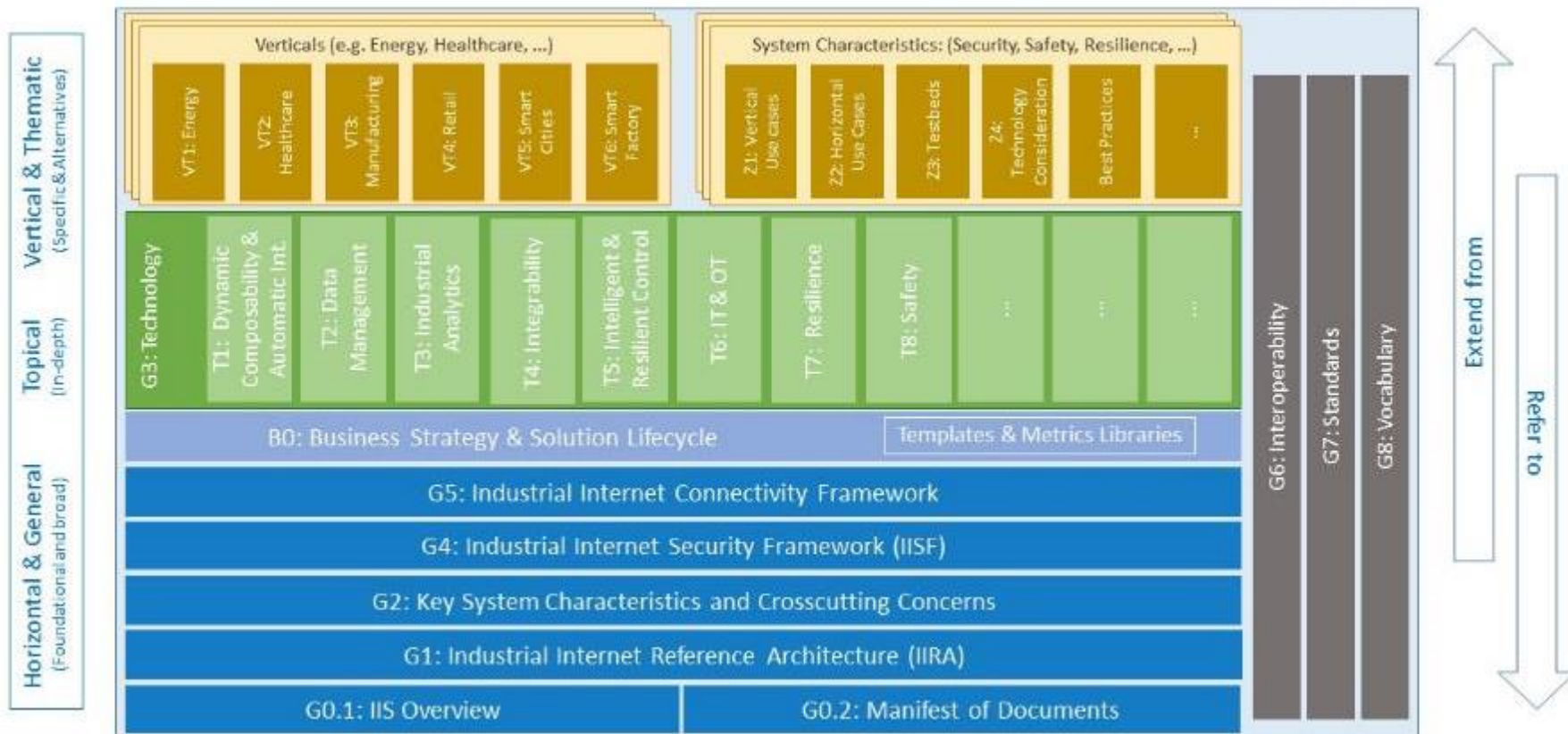
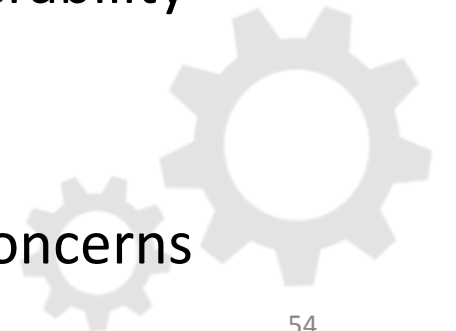


Figure 1-1 IIC Technical Publication Organization



Key takeaways

- As a fledgling discipline combining advances in mathematics, computer science and engineering in the context of Information Technologies (IT) and Operational Technologies (OT) convergence, industrial analytics plays a crucial role in the success of any IIoT system
- The IIAF is the first blueprint that decision makers, such as IIoT system architects and business leaders, can use to deploy industrial analytics systems
- The IIAF provides a common understanding and encourages interoperability across the IIoT ecosystem
- Takes into account industrial requirements, goals and cross-cutting concerns





Agenda

Overview of IIC

Industrial Analytics Task Group: Overview and Motivation

Industrial Analytics Framework (IIAF)

Looking Ahead: What's on the Horizon for Industrial Analytics

Concluding Remarks





Industrial Analytics Task Group

What is on the Horizon for Industrial Analytics

It is a very exciting time to be working on analytics, please join us!

- Tremendous reception to the IIC White Paper and IIAF
- Emerging technologies such as Big Data and AI fueling the analytics evolution
- Increasing recognition of the its importance and real world deployment

Evangelize the work of IIC on Analytics

- Continue with the rollout of IIAF and related publications (e.g. JOI)
- Translation of IA TG deliverables
- Extension of deliverables for specific geographies and verticals
- Engage with liaisons, develop new liaisons, expert speakers and planning panels

Launch work on the next release of the framework – IIAF 2.0

- Brainstorming on next gen work including depth, breadth, cross-cutting, verticals etc.
- Formalizing the ideas into a plan and starting the work on the document

Within IIC, develop crosscutting areas further and deeper collaboration with Testbeds and BSSL

Goal is build upon the successful IIAF and continue to expand the IA blueprint 56



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Concluding Remarks: It Takes An Ecosystem!

Big Data, Analytics and IoT are **3 sides of the same coin!**

- IoT is focused on sensor networks that *source* the data
- Big Data is focused on compute architectures that *process* the data
- Analytics is focused on the *consumption* of the data to *create value*

Successfully deploying industrial analytics is key to realizing the full IIoT business potential

- Requires consideration of the technology, industrial requirements, vertical applications driving the business and a look at the entire platform

IIAF is a first-of-its-kind blueprint for decision makers that addresses the entire ecosystem

IIC, its Technology WG and IA TG are working with a coalition of partners. For instance*

- IIAF that defines the overall framework, business drivers and reference requirements
- ISO/IEC JTC 1/WG 9 (Big Data) is looking at the compute BDRA
- ECC is working on edge technologies
- CAICT/AII is looking at the entire ecosystem and providing a China perspective

* Above not a comprehensive list but for example



Concluding Remarks: IIC Analytics White Paper and Framework Useful Links

IIAF (Published 1017)

https://www.iiconsortium.org/pdf/IIC_Industrial_Analytics_Framework_Oct_2017.pdf

White Paper (Published 0317)

https://www.iiconsortium.org/pdf/Industrial_Analytics-the_engine_driving_IIoT_revolution_20170321_FINAL.pdf

Press release on IIAF

<http://www.businesswire.com/news/home/20171024005049/en/Industrial-Internet-Consortium-Publishes-Industrial-IoT-Analytics>

Video Discussing IIC's Industrial Analytics

<https://youtu.be/g0rs5YIMqtA>





Community. Collaboration. Convergence.

Things are coming together.

www.iiconsortium.org

