Overview of IIC and the Emerging Industrial IoT, AI and Analytics Ecosystem

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IoT International Symposium 2018

Acknowledgements

Eric Harper (ABB)

Shi-wan Lin (Thingswise)

Edy Liongosari (Accenture)

Terry McElrath (IIC)

Stephen Mellor (IIC)

Will Sobel (Vimana)

Agenda

Overview of IIC

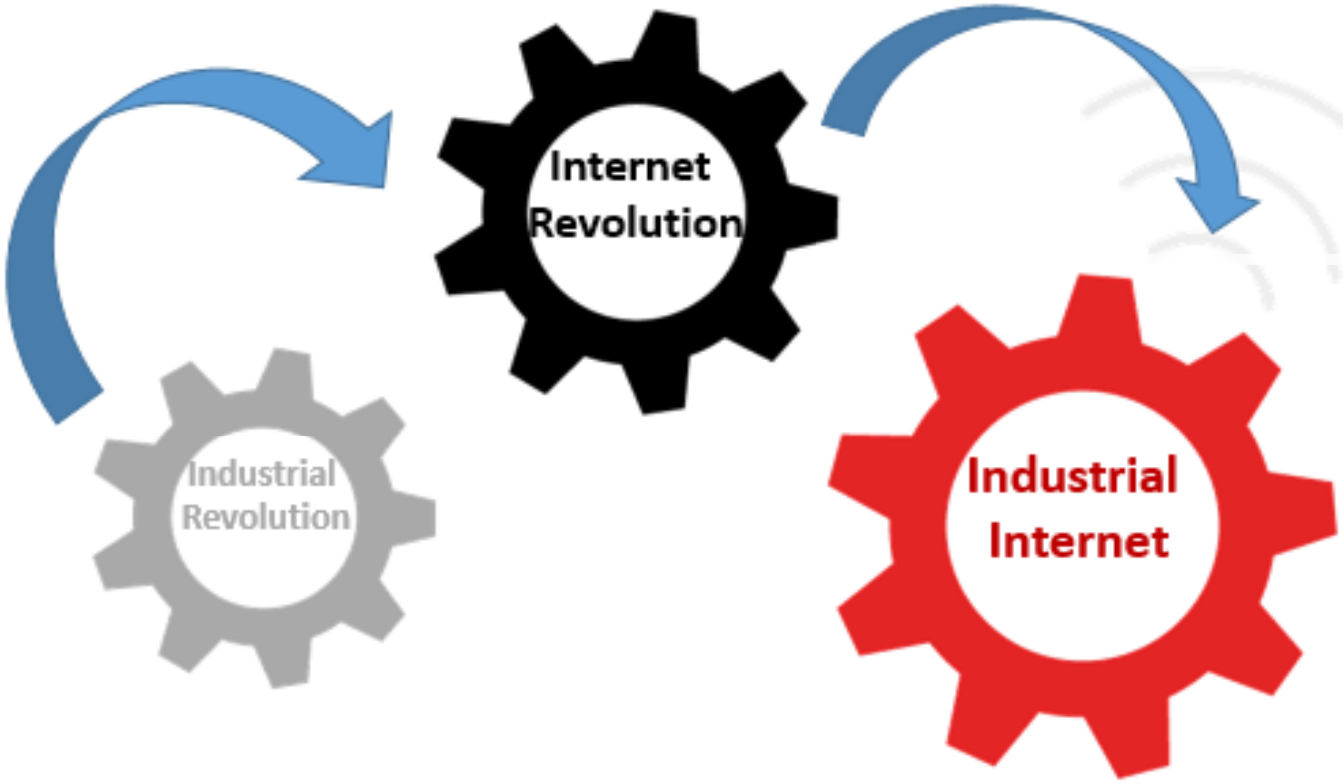
Industrial AI Task Group: Overview and Motivation

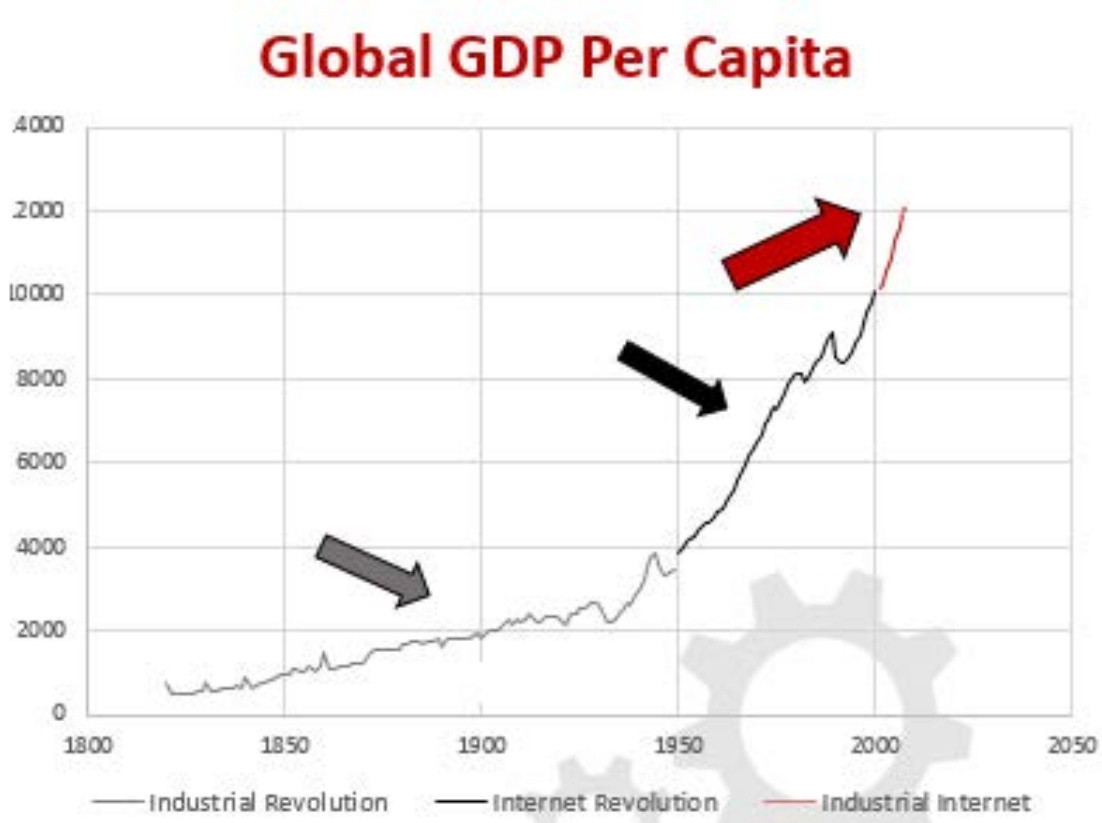
Industrial Analytics Framework (IIAF)

Concluding Remarks

Getting Involved

The Industrial Internet is leading the next economic revolution





GDP data extracted from the Futurist 2007

Yet there are current roadblocks to widespread adoption

59% of IT Pros Say They **Have Not Started Preparing** for Expected Data Increase

73% of Companies Have **Not** Made **Concrete Plans** for the Industrial Internet

3% of IoT Professionals Say **Connectivity** is the Biggest Challenge

Many Countries Have **Insufficient Conditions** to Support **Widespread Adoption**

Data Standards are Largely **Proprietary**, **Works-in-Progress**, or **Non-Existent**

The Industrial Internet: A $32 trillion opportunity

14% of IoT Professionals Say **Security** is the Biggest Challenge

70% of IoT Professionals Say **Interoperability** is the Biggest Challenge

36% of Executives Say **System Barriers** Between Departments **Prevent Collection** and Correlation of Data

Research into the Industrial Internet has **Only Existed** in the **Past 3 Years**

Urgent Need to **Refocus Education** to Prepare for the **Upcoming Digital Workplace**

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

ABB
ERICSSON
at&t
OLYMPUS
TOSHIBA
Hewlett Packard Enterprise
Itron
HCL
accenture
DELL
KUKA
Rostelecom
BOEING
TOYOTA
TÜV SÜD
MITSUBISHI HEAVY INDUSTRIES
Schindler
MICHELIN
SAMSUNG
HITACHI
infineon
INTERDIGITAL.
HARTING
iot INSTITUTE
ORACLE
pitney bowes
Haier
KONICA MINOLTA
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cisco
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Infosys
Micron
NATIONAL INSTRUMENTS
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ptc
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Changes for the Better
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ALL PROGRAMMABLE
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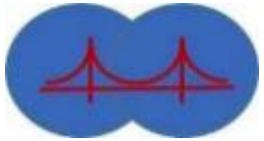
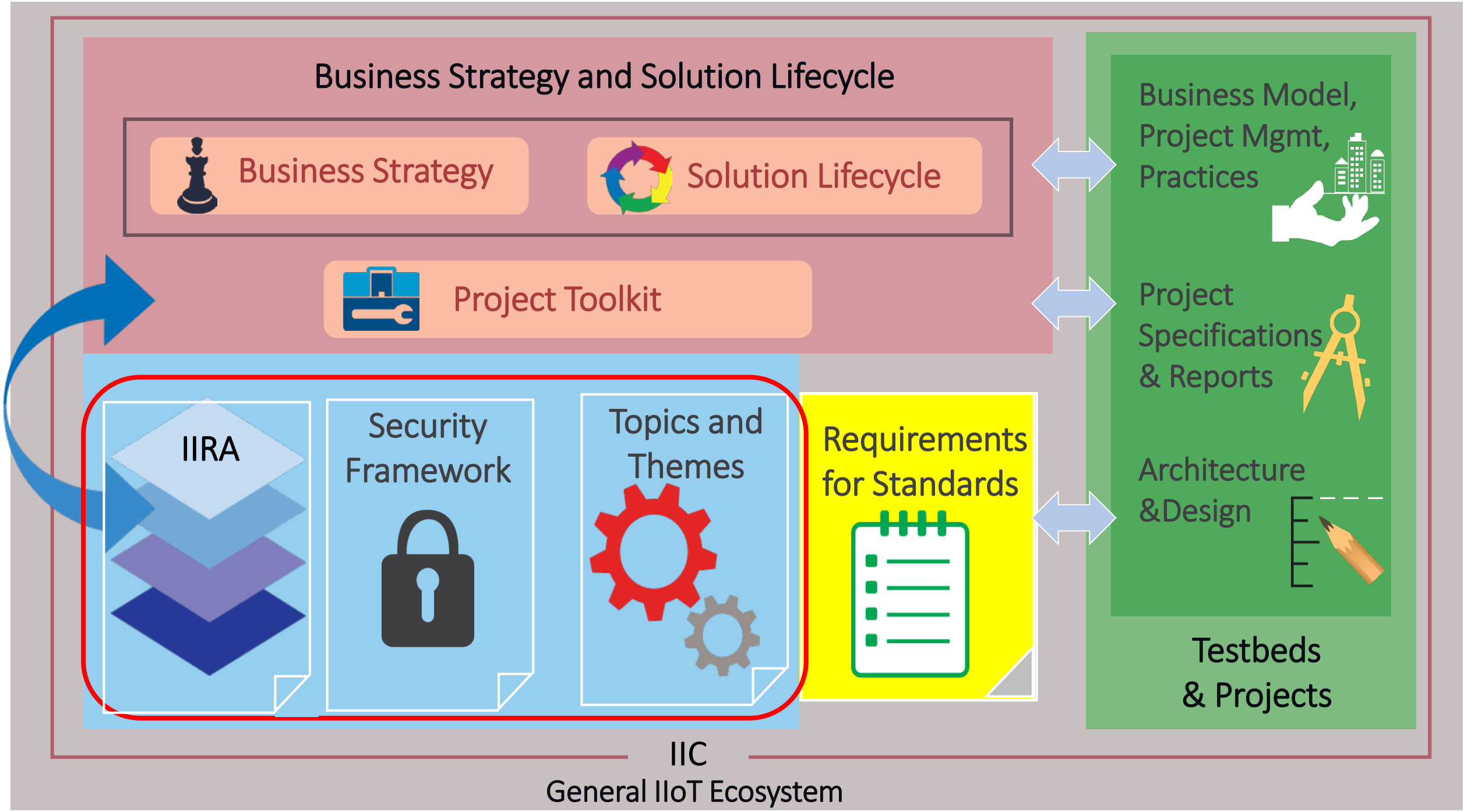
IIC Founders, Contributing Members, & Large Industry Members

IIC Small Industry Members

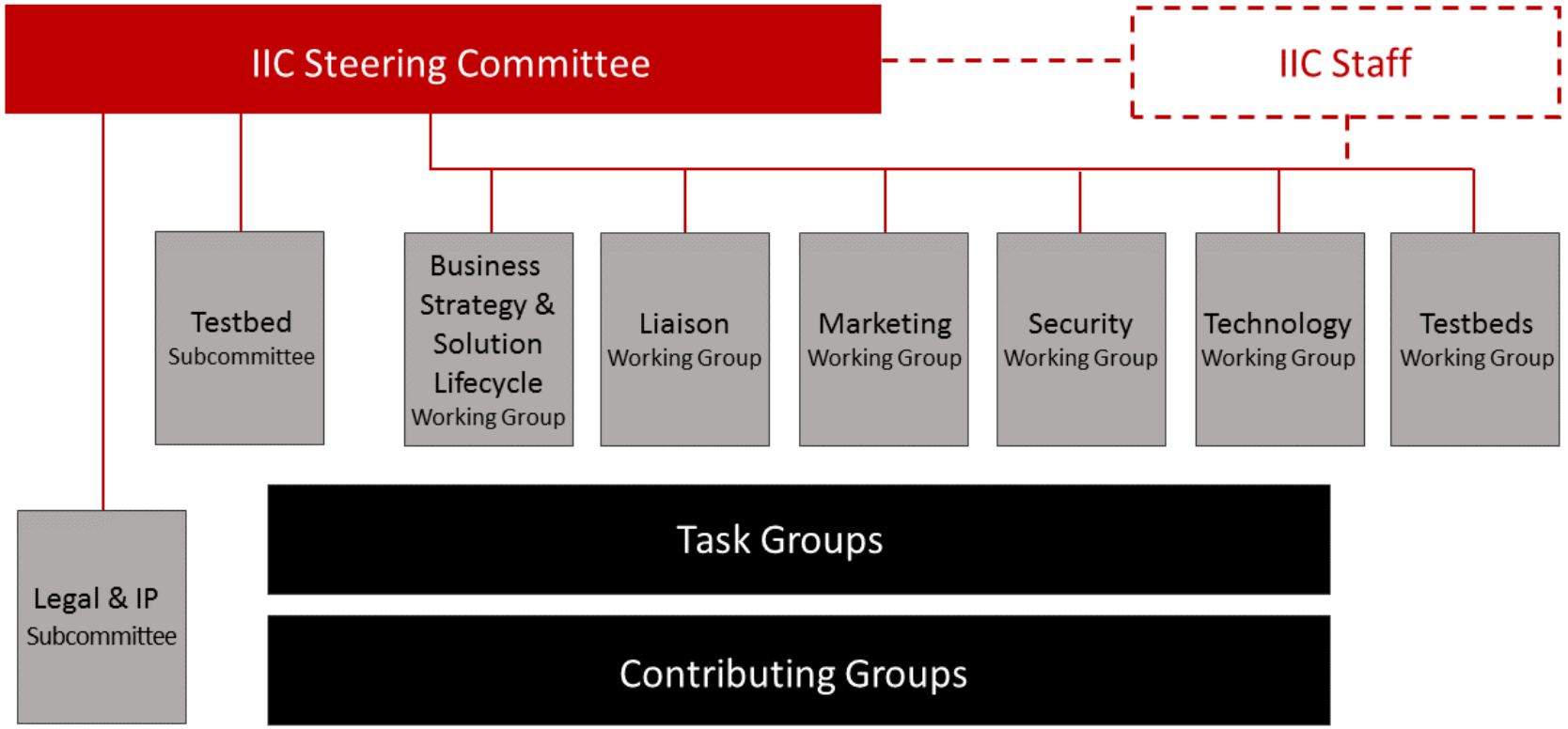
IIC Small Industry Members



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



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.

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

System Engineers
Product Managers
System Architects

Architects
Engineers
Developers
Integrators
Deployment
Operations

Why

What

Verb

Noun

How

biz values, objectives & capabilities
Business Viewpoint

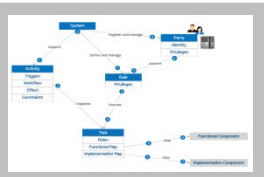
Usage activities
Usage Viewpoint

Functional decomposition & structure
Interfaces & interactions
Functional Viewpoint

Activity &functional to technologies mapping
Implementation Viewpoint

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 36 existing liaisons and currently has 30 more in flight!

That's impressive for an organization that has its 4th birthday on March 27th, 2018!

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)
- **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/WG 10 (IoT), IEEE P2413 and 802.24 etc.
- Liaison partnerships with global **SDOs focused on related areas**
  - JTC 1/WG 9 (Big Data)

Building Coalitions to Address the IoT Ecosystem

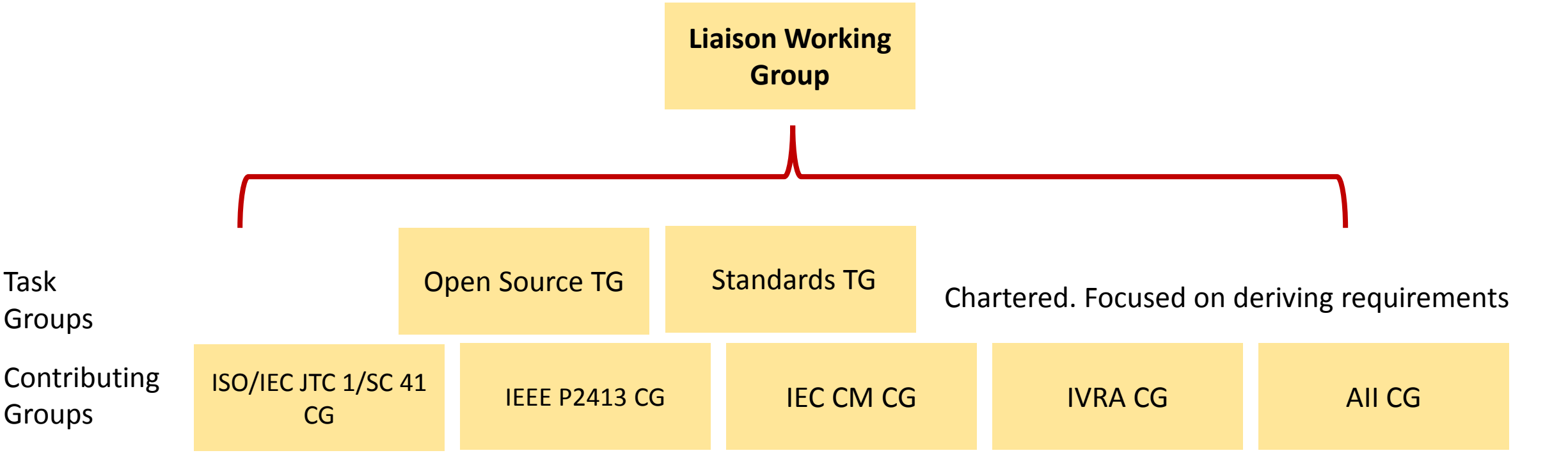
Liaison Working Group Coordination Objectives

- Coordinate and work with internal stakeholder groups
- Coordinate with the IIC Marketing Working Group on press coverage related to liaison agreements
- Coordinate with the IIC Steering Committee Legal Sub-Committee and IIC council for review of agreements when needed

Liaison Working Group Operational Objectives

- Act as the central point within IIC for communicating with partner organizations
- Evaluate benefits to the IIC of a proposed liaison
- Identify internal stakeholder groups (e.g. IIC task groups and/or working groups) that would benefit for a proposed liaison
- Draft liaison agreements with candidate partner organizations. The Agreements developed by the Liaison Working Group may
  - Enable IIC and its liaison partner pursue related and mutually beneficial goals (e.g., exchange of information, definitions, testbeds, use cases, demonstration projects, technical specifications, standards and harmonize architectures)
  - List collaboration areas
  - Document the commitments from both organizations
- Make recommendations for approval to the IIC Steering Committee on proposed liaison agreements
- Direct both internal and external communications regarding the focus of the liaison

Liaison Working Group – February 2018



The IIC and standards organizations

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.

Marketing Working Group

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

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GE Software

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

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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 Connext® 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 Connext Secure easily to any legacy system

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accenture

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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BAYSHORE
INDUSTRIAL-STRENGTH CYBERSECURITY
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

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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Testbed Working Group

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

Testbed Lifecycle Phases

Task:	What? Why?	How? How Much?	Create	Experiment
Phase:	Concept	Feasibility	Development	Operation
Goal:	Approval	Planned/Resourced	Operational	Results

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

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?

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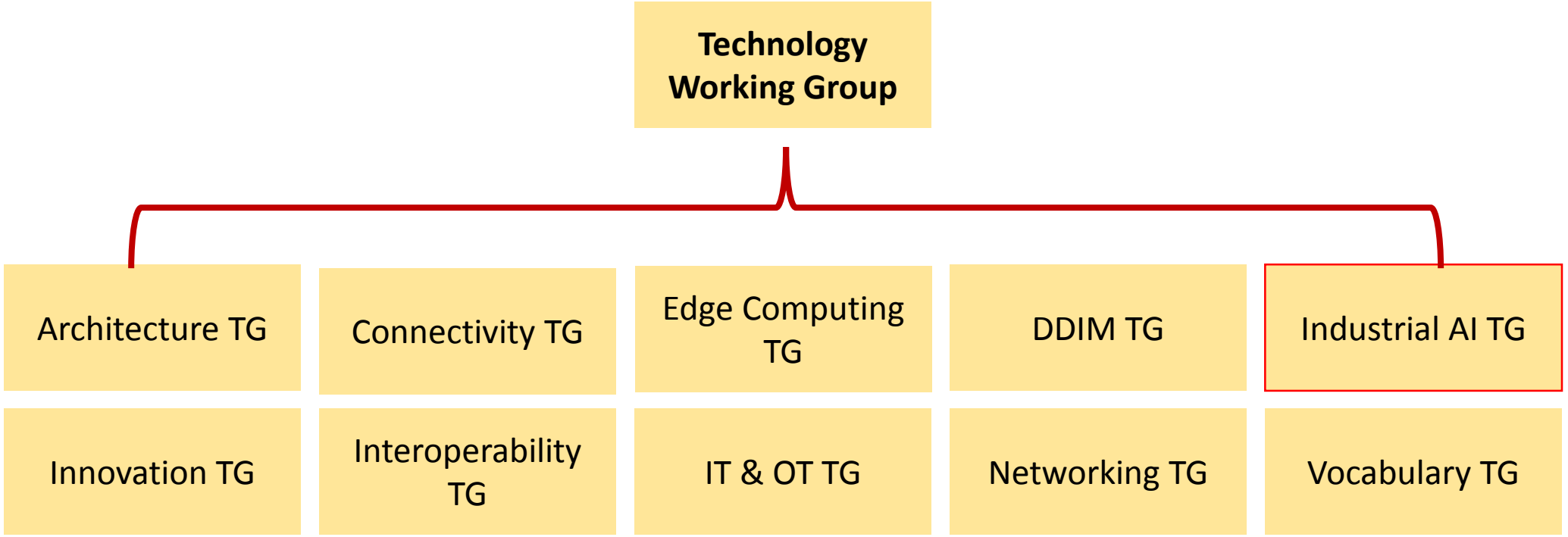
Technology Working Group Organization



Industrial AI Task Group
Work and Deliverables Landscape

Renamed from **Industrial Analytics Task Group -> Industrial AI Task Group** 0218

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**
- Q4 2018 for second release of Framework ← **Initial exploratory phase**
- Q? 2018 for release of AI White Paper ← **Initial exploratory phase**

Internal stakeholder for liaison relationships

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

Membership engagement Initiatives

- Invited speakers
- Host expert panels (session and plenary)

Represent IIC AI/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 and AI interests within TWG 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 WOR
BIG DATA 14-AUG-2

AGENDA

08:30 – 09:15 **Coffee + Registration**

09:15 – 09:30 Welcome
Ray Walshe CHAIR of IWBD
Enda McDonnell, Director o

09:30 – 09:45 Official Opening
Adrienne Harrington
Head of Data Protection Uni
Irish Government Dept. of a

09:45 – 10:00 Special Guest
Daniele Rizzi - EC DG CNEC
European Standardisation P

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 CENEL
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**

NSAI BDV BIG DATA VALUE ASSOCIATION ISO

IWBDS'17

International Workshop on Big Data Standardisation

14th Aug 2017 @ Dublin City University

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

Giorgios 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://iwbds17.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

RRI:IIC Announcement Ceremony
RRI International Symposium, Tokyo, November

IIC:IVI Workshop @Tokyo Big Sight

>220 Registered Attendees (limited by space)

IoT International Symposium 2017 (MIC / ITAC) in Tokyo 0317

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Getting Involved

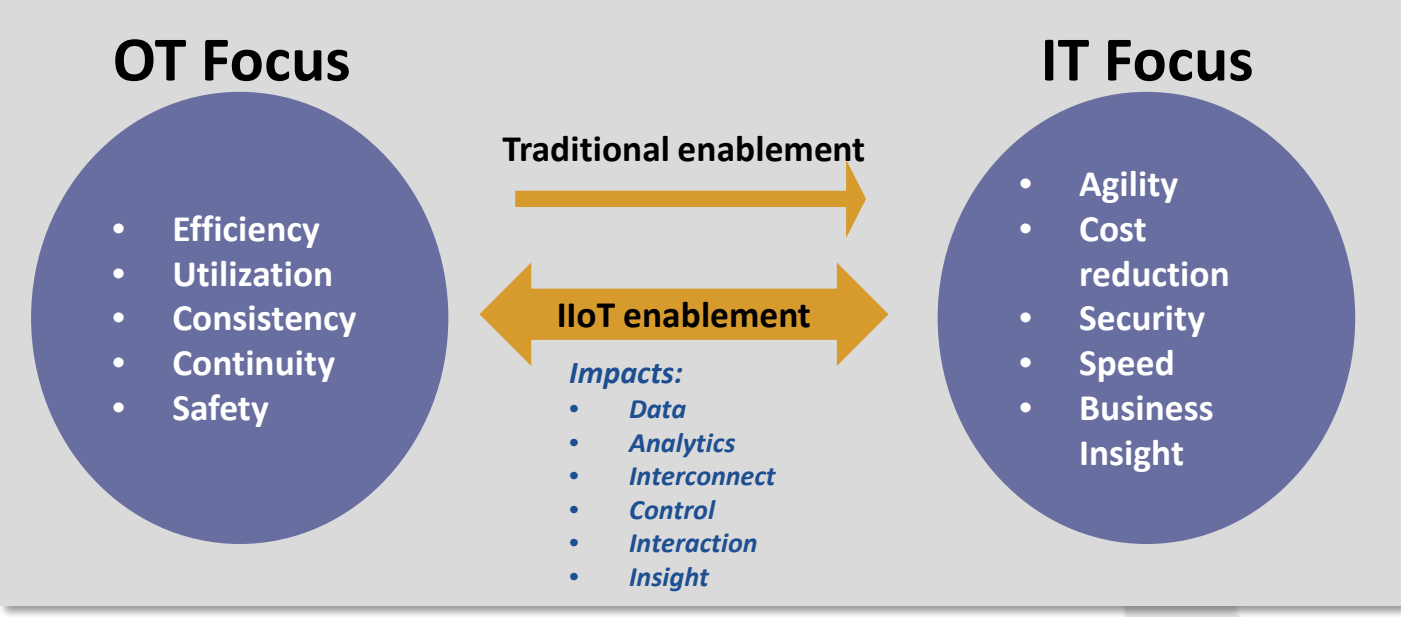
Introducing IIAF

- 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

Stakeholders

Biz decision makers
System Engineers
Product Managers

Why

biz values, objectives & capabilities

Business Viewpoint

System Engineers
Product Managers
System Architects

Verb

Usage activities

Usage Viewpoint

What

Functional decomposition & structure
Interfaces & interactions

Functional Viewpoint

Noun

Architects
Engineers
Developers
Integrators
Deployment
Operations

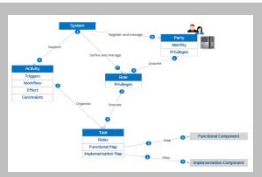
Activity &functional to technologies mapping

Implementation Viewpoint

How

Biz View

Usage View



Functional View

Implementation View

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."

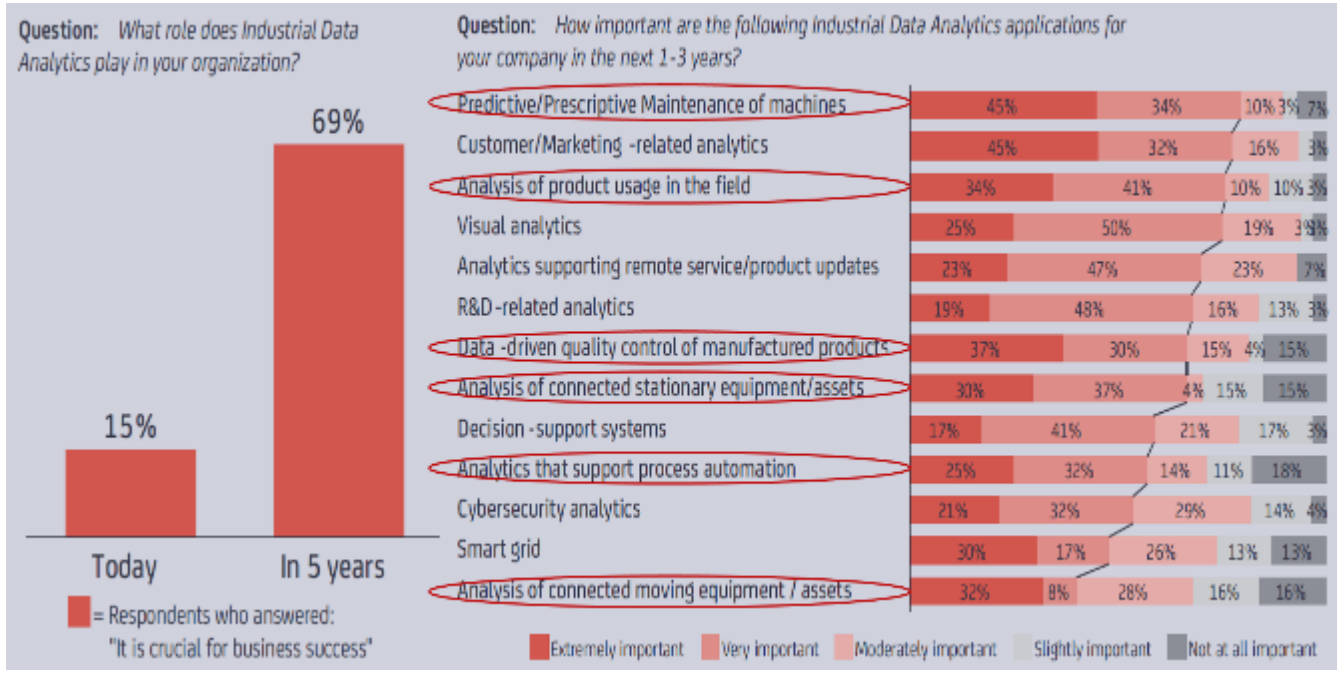
What is it? Attends to concerns of the identification of stakeholders and their business vision, values and objectives in establishing an industrial analytics system in its business and regulatory context

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 conside 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

Correctness	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.
Timing	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.
Safety	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.
Contextualized	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.
Causal-oriented	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**

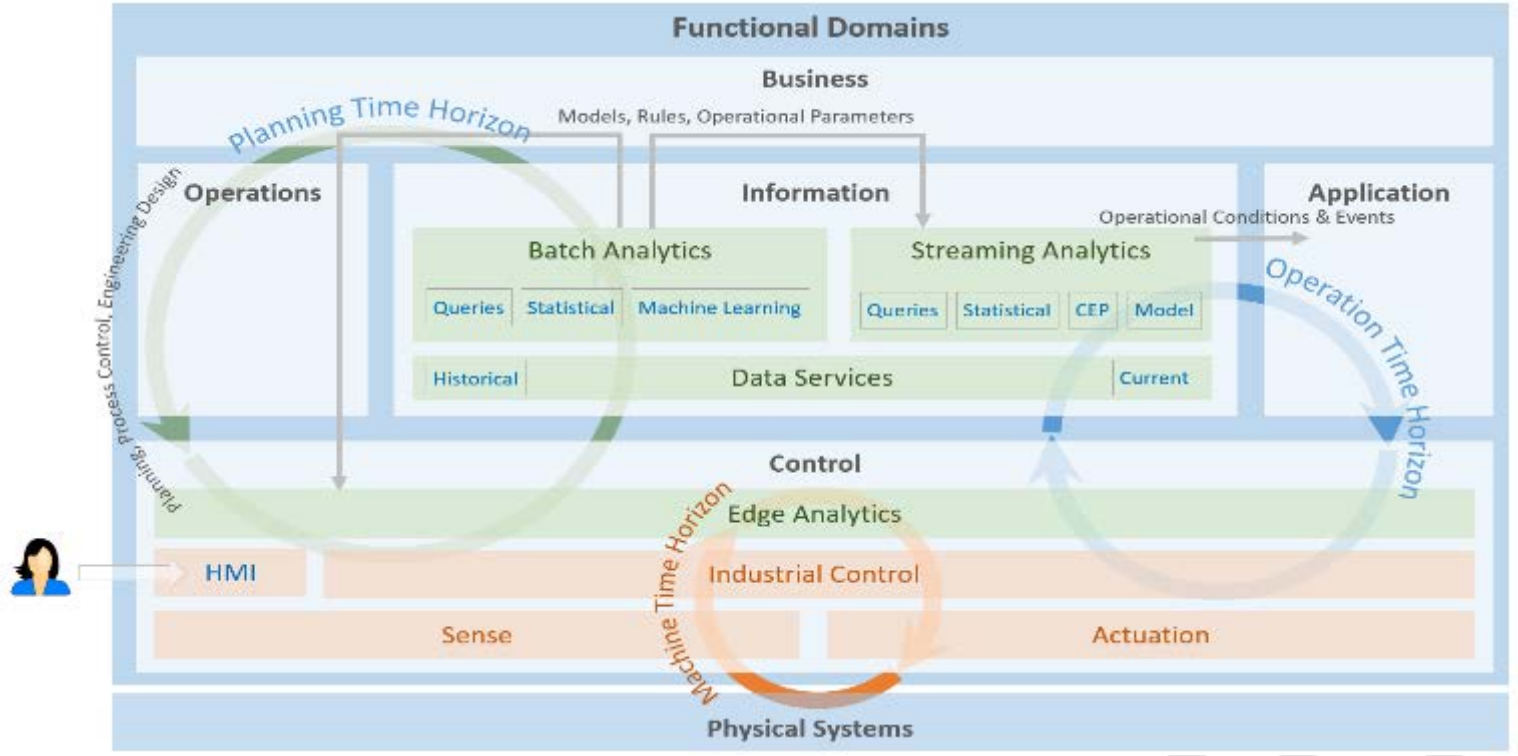


Figure 4-1. Analytics Mapping to the Industrial Internet Reference Architecture

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

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

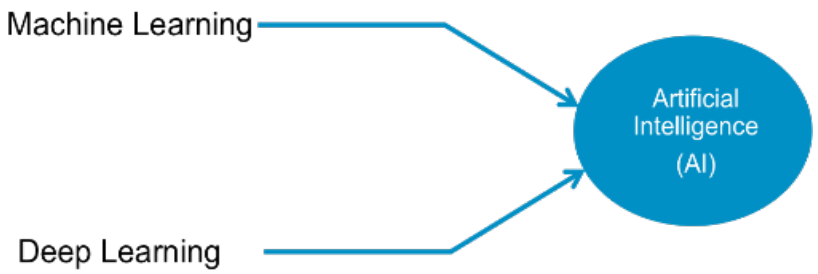


Figure 6-2 Artificial Intelligence (AI)

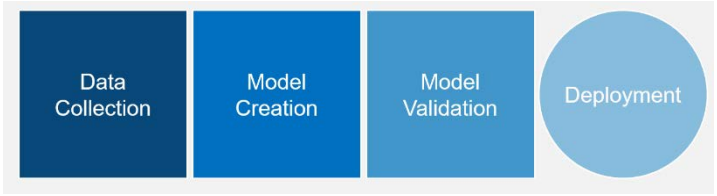
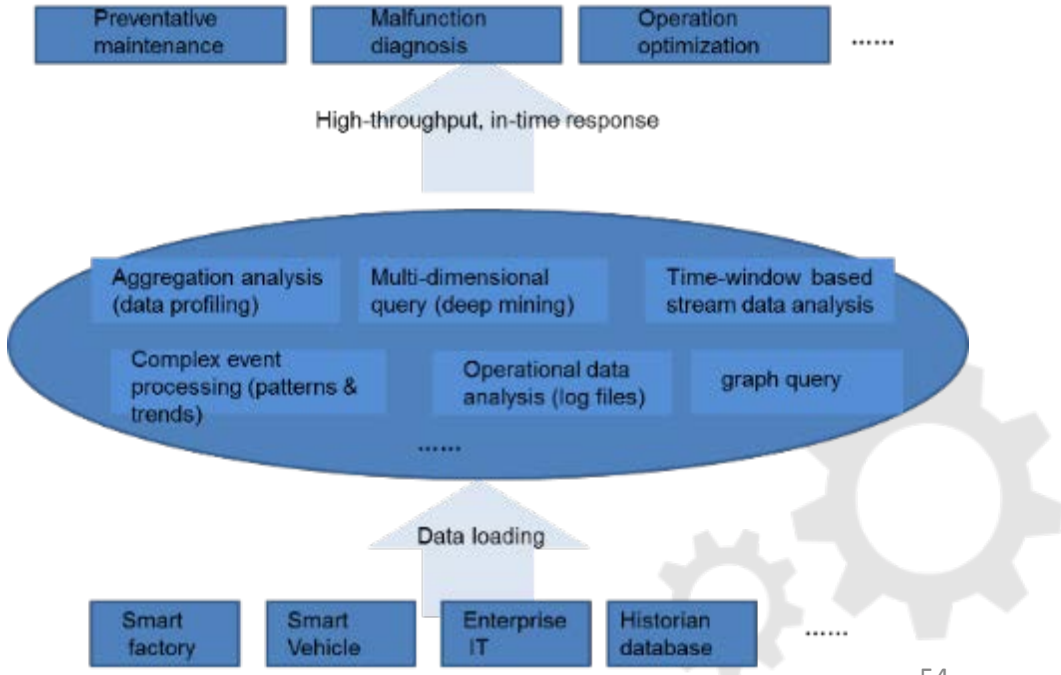


Figure 6-8 Deep learning workflow

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



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

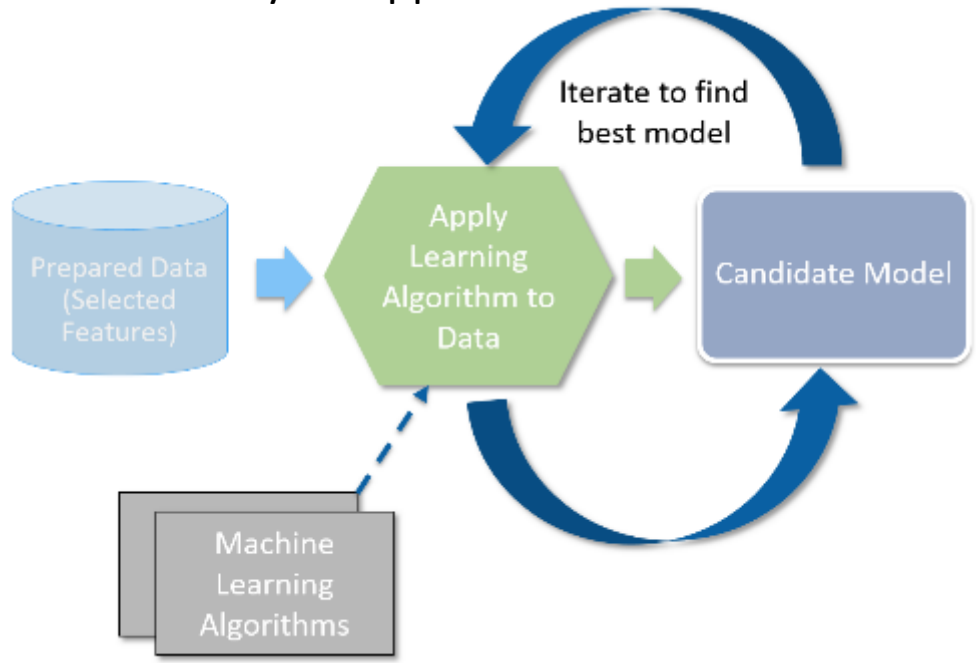


Figure 7-4 The model building process

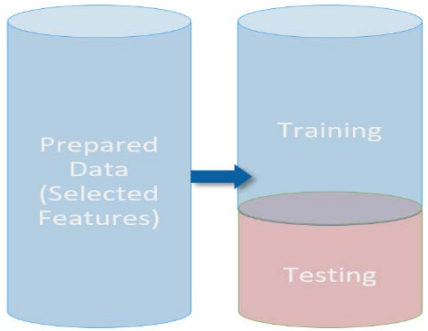


Figure 7-5 Splitting data for cross validation

		Predicted Condition	
	Total Population	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

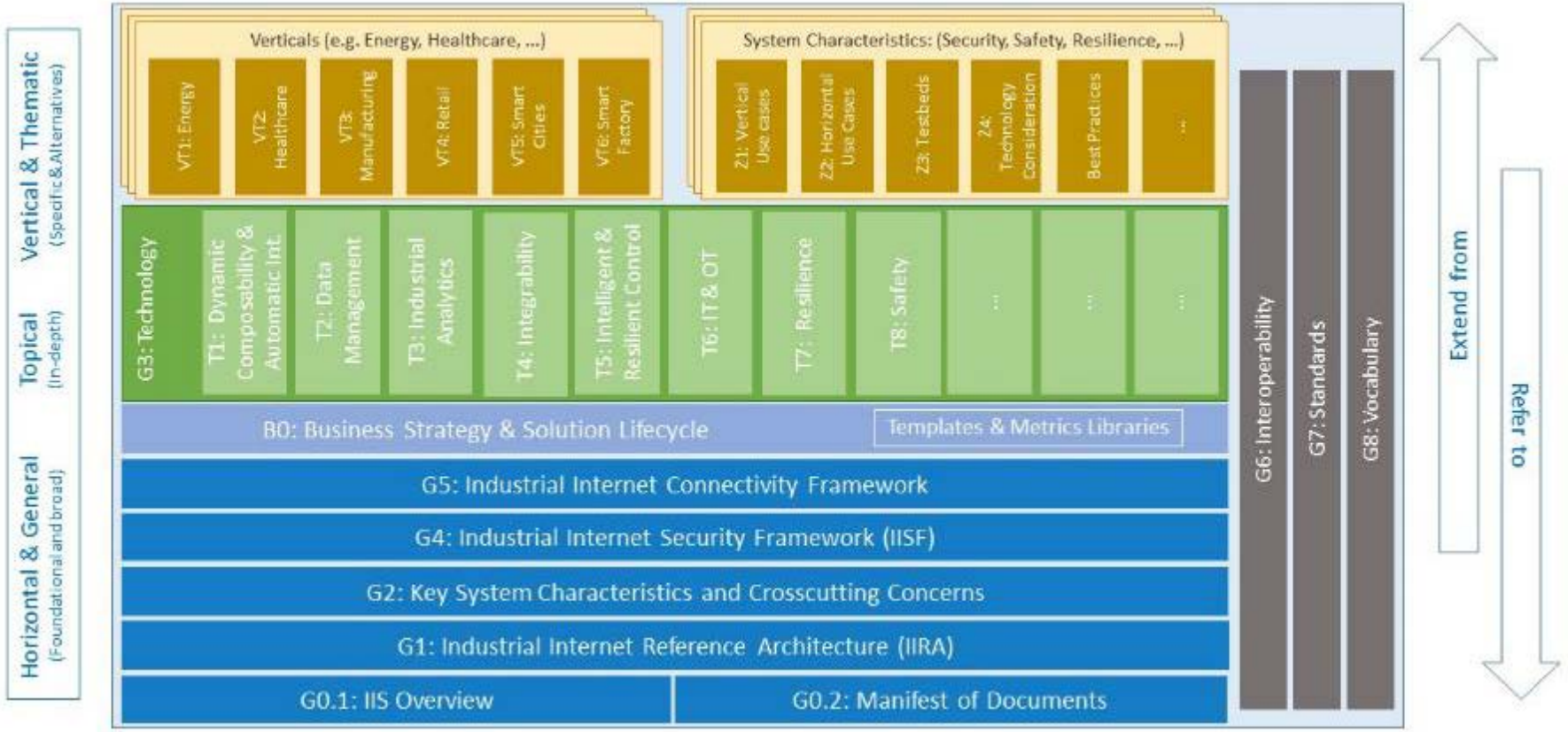


Figure 1-1 IIC Technical Publication Organization

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 rule 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

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 – Longer Conversational Style

https://youtu.be/g0rs5YlMqtA

Video Overviewing the Industrial Analytics Framework – Shorter Clips Style

https://www.youtube.com/watch?v=oLmitX5eW08

Agenda

Overview of IIC

Industrial AI Task Group: Overview and Motivation

Industrial Analytics Framework (IIAF)

Concluding Remarks

Getting Involved

Concluding Remarks: It Takes An Ecosystem!

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

- IoT is focused on sensor networks that *source* the data
- AI (and Big Data) are enabling technologies focused on machine learning, algorithms and architectures that *learn and process* the data
- Analytics is focused on the use of the processed date *insights and business 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 TWG, LWG and IAI TG are working with a coalition of partners.

Agenda

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Getting Involved

Getting Involved: IIC IAI TG Expert Panels 0518

- IIC's Industrial Analytics Task Group will host two expert panels at the IIC Q2 Meeting
  - Panel 1 – Industrial Analytics
    - Theme: on the expectations for, and interactions with, analytics across the technology areas. How are you applying analytics to industrial applications and what value does your solution bring to your customers and stakeholders?
    - Moderator: Eric Harper (ABB)
  - Panel 2 – Industrial AI
    - Theme: on the expectations for, and interactions with, AI across the industrial area. Where are your successes or issues using AI in the industrial settings? What have you learned? What are the compelling stories that encourage customers to engage with your solutions?
  - The goal of both panels is to bring experts from both IT and OT sides to discuss the importance, challenges and directions that these technology areas are taking in the industrial internet as well as how this fits within the ecosystem
- Instructions for Interested Panelists
  - We welcome interested panelists to submit an email:
  - If you are an IIC member to: iic-ai-team-chair@workspace.iiconsortium.org. If not, send to me please
  - Subject: Request for Panelist Opportunity at IIC Industrial [Analytics|AI] Panel May 2018
  - Body:
    - <please include a brief bio about yourself>
    - <please include a brief statement about your interest in joining the panel>
- Important Dates
  - Call for Panelist Deadline: April 25th, 2018
  - Response from Organizing Committee for Requests: May 7th, 2018

Getting Involved: IoTSWC 2018

- IoT Solutions World Congress (IoTSWC) is partnership between Fira Barcelona and IIC
- Successful 2017 event
  - 13,000 visitors (8,134 in 2016)
  - 250 speakers (160 in 2016)
  - 240 exhibitors and sponsors (170 in 2016)
  - 114 Countries (71 in 2016)
  - 24,000 square meters (14,000 in 2016)
- IoTSWC 2018
  - Key dates
    - Call for papers opened January 9th, 2018
    - Call for papers closes 16th April, 2018
    - Review and approval of papers by Program Committee from close till 31st May, 2018
    - Program up on the website 10th June, 2018
    - Congress runs 16th – 18th October
  - 7 tracks
    - Manufacturing, Energy & Utilities, Buildings & Infrastructure, Healthcare, Open Industry, Enabling Technologies
  - 2 Forums
    - Artificial Intelligence & Cognitive Systems
      - AI and Cognitive Systems Forum will run through the entire congress
    - Blockchain

Track Chairs

Manufacturing: *Helena Lisachuk and Calvin Smith*

Connected Transporation: *Jamie Smith and Said Tabet*

Energy & Utilities: *Eric Harper & Jeff Lund*

Buildings & Infrastructure: *Leila Dillon and Ron Zahavi*

Healthcare: *John Denning and Helena Lisachuk*

Open Industry: *Mark Crawford and Tim Scannell*

Artificial Intelligence: *Edy Liongosari and Wael William Diab*

Enabling Technologies: *Edy Liongosari and Shyam Nath*

Getting Involved: IoTSWC 2018 – AI Forum

Come and learn how adding Artificial Intelligence to Industry Internet of Things (IIoT) Solutions can completely transform and bring the solutions to the next level. Enhanced insights, complex decision making, self-learning and self-healing are just a few of the capabilities that AI enables. It also provides much more sophisticated user interactions and richer experiences. The possibilities that AI brings to IIoT are endless. Hear the success stories of how AI is applied to IIoT systems and get a look at how this emerging technology is changing the industry and landscape. Topics Include:

- Applications, use cases and/or vertical industry use cases of AI in IIoT
- AI computational techniques (e.g. machine learning, genetic algorithms, etc.)
- Algorithmic training, landscape and open source
- AI system architectures and related technologies (e.g. Big Data)
- AI Security, Privacy and Trustworthiness
- AI system development and deployment processes, methodologies and best practices
- Infrastructures supporting AI-enabled IIoT systems
- AI ethical considerations (e.g. algorithmic bias)
- Societal impact of AI
- Emerging industry ecosystem and landscape (e.g. standardization, industry alliances, etc.)

Community. Collaboration. Convergence.

Things are coming together.

www.iiconsortium.org

March 2018