OBJECT MANAGEMENT GROUP

IIoT standards at work

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Introducing OMG

- One of the most successful forums for creating open integration standards in the computer industry
  - Middleware platforms (DDS, CORBA & related specs)
  - Modelling platforms (UML, BPMN, SysML & related work)
  - Systems Assurance (SACM, DAF for SSCD ...)
  - Vertical domain specifications (C4I, Robotics, Healthcare ...)
- Member-controlled industrial consortium
  - Both vendors and users
  - Not-for-profit
- Interfaces freely available to all
  - Visit http://www.omg.org

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Worldwide Membership

ACORD	EDM Council	Microsoft	OSD	Sparx
Adaptive	EMC	Micro Focus	Penn Nat'l	State St
Adelard LLP	FICO	MID GmbH	PrismTech	Thales
Airbus Grp	FSTC/BITS	MITRE	PROSTEP AG	Thematix
Appian	Fujitsu	Mitsubishi	PTC	TIBCO
AT&T	Gen. Electric	Mphasis	PwC	Toshiba
BAE Systems	HPe	NASA	Remedy IT	Toyota
Bizagi	Honda	NARA	Rolls-Royce	Twin Oaks
Bloomberg	Huawei	NEC	RTI	Unisys
Boeing	IBM	No Magic	SAP	VDMbee
CA	KDM Analytic	Northrop	Selex ES	Visumpoint
Camunda	Lockheed	Oracle	Softeam	WebRatio
Eclipse Fndn.	MEGA	Orbus	Software AG	(200+ more)

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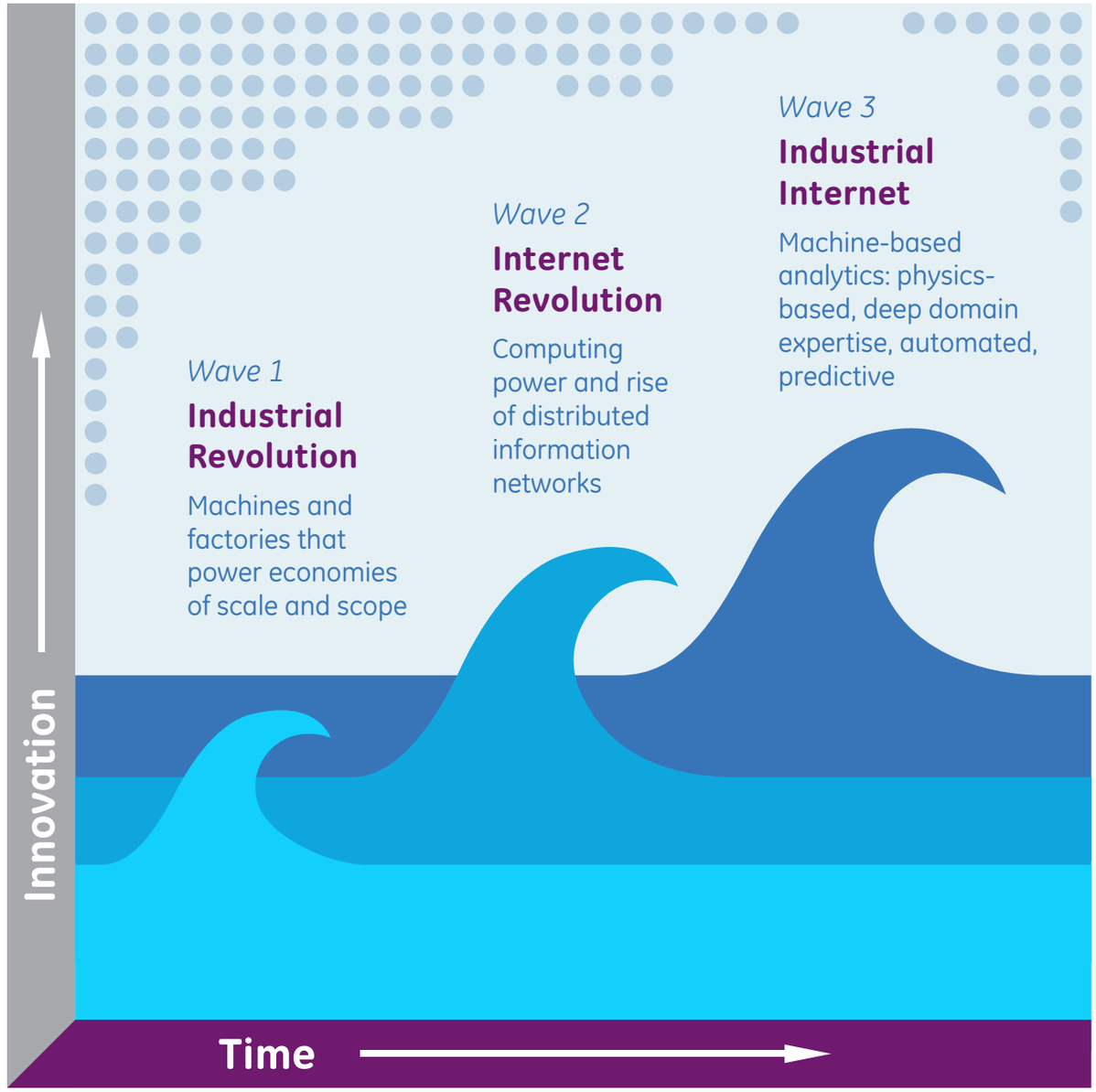
IIoT: The Next Economic Revolution?

- **Industrial revolution replaced muscle power with machines**
  - **Dramatic, continuing rise in global living standards began**
- **Information revolution similarly boosted brain power**
- **Their convergence promises further wave of rising productivity and prosperity**



Source: Evans & Annunziata, GE, 26 Nov 2012

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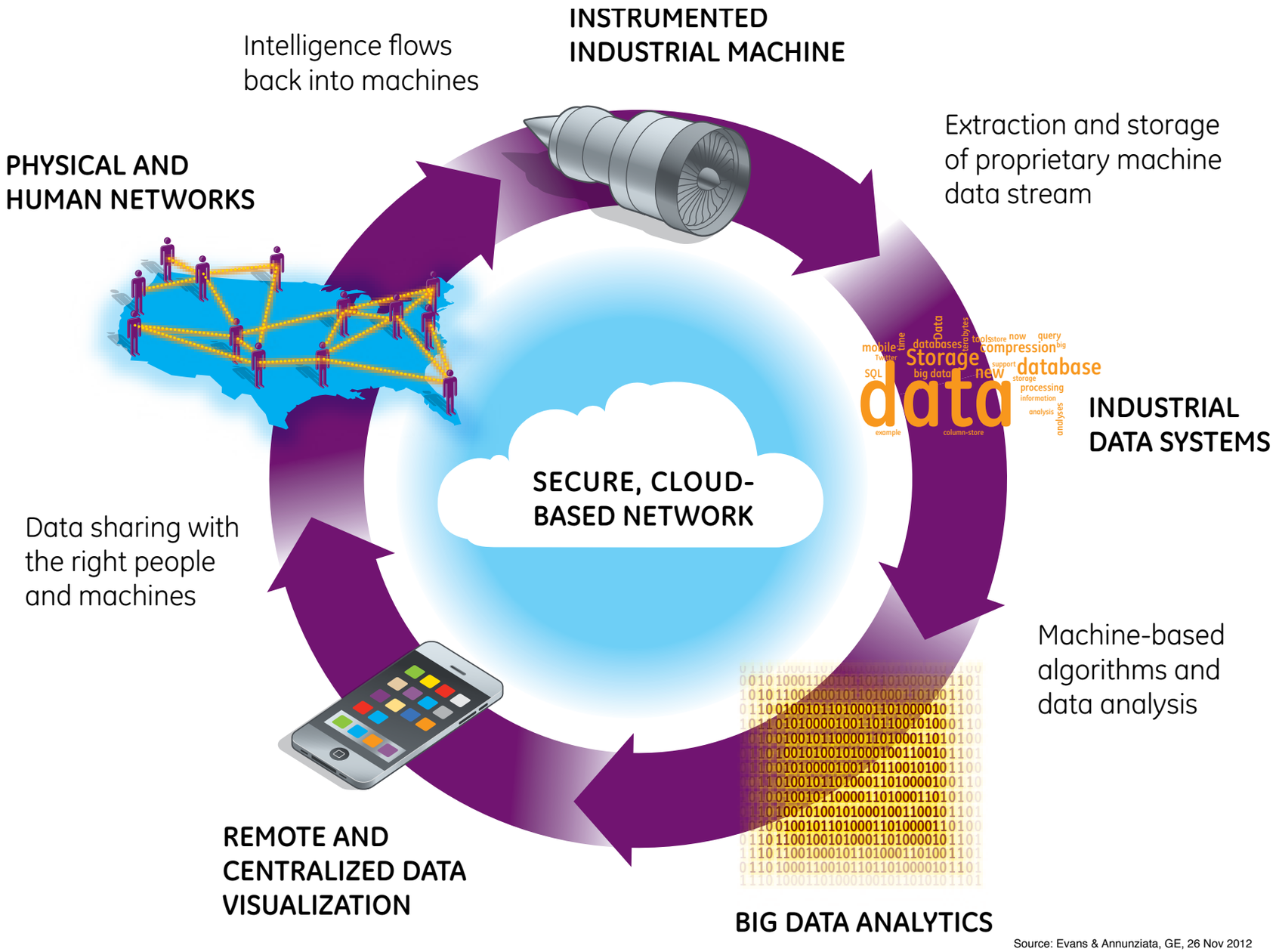
Industrial Internet Data Loop



Source: Evans & Annunziata, GE, 26 Nov 2012

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The Numbers

- GPS-guided John Deere tractors seed fields with no overlaps or gaps between traverses
  - 10% cost saving = £40/acre (€150/hectare) for cereal farmer
- GPS-guided John Deere harvesters runs continuously at optimum 7 kph all day, not human operator's typical 5 kph
  - Harvests 30% more in a day, optimising equipment use & weather windows, reducing operator fatigue
- Volvo excavators programmed with CAD model of hole to dig
  - 10-20% faster than human operator
- ASDA lorries' deliveries planned & tracked via GPS
  - 5-10% cost savings, precise prediction of delivery times

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The Risks

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Cyberattack on German steel factory causes 'massive damage'

By Loek Essers FOLLOW

IDG News Service | December 19, 2014

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Security

A German steel factory suffered massive damage after hackers managed to access production networks, allowing them to tamper with the controls of a blast furnace, the government said in its annual IT security report.

INSIDER

The report, published Wednesday by the Federal Office for Information Security (BSI), revealed one of the rare instances in which a digital attack actually caused physical damage.

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4.5 million routers hacked in Brazil – Infosecurity Magazine

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2 OCT 2012 | NEWS

4.5 million routers hacked in Brazil

Some 300,000 modems in Brazil are still thought to be controlled by attackers

The forensic breakdown of the attack came first from Fabio Assolini, a researcher for Kaspersky Labs, during a presentation at the Virus Bulletin conference. Graham Cluley at Sophos recounted the presentation in his blog.

Assolini described how at some Brazilian ISPs, more than 50% of users were reported to have been affected by the attack. After the six manufacturers affected issued firmware updates to plug the security hole, the number of compromised modems decreased. However, some 300,000 modems are still thought to be controlled by attackers.

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3 Most Important IIoT Design Policy goals

- **Safety**
  - Does not cause physical injury or damage to health (either directly, or via damage to property & the environment)
- **Security**
  - No unintended or unauthorised access, change or destruction of system or data & information it contains
- **Resilience**
  - System avoids, absorbs & manages dynamic adversarial conditions while completing assigned mission(s), reconstitutes operational capabilities after casualties

Source: Industrial Internet Reference Architecture
http://www.iiconsortium.org/IIRA.htm

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Demanding requirements

- **Safe, secure & resilient systems**
  - **Documenting & then achieving all design goals, even in the face of bad actors attempting remote interference**
- **Designers who have tools & skills that cut across multiple engineering disciplines, data science, cyber security, UIs**
  - **Squeezing inefficiencies out of complex systems**
- **Sensors & advanced instrumentation embedded in machines**
  - **Enormous data volumes distributed & analysed in real time**
- **Widely-used standards support all these**
  - ***Already*** **enabling IIoT-based innovation**
  - **Some relevant OMG activities ...**

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Assurance

- **Measure of confidence that system meets policy goals**
- **Information Assurance (IA)**
  - **Availability, integrity, confidentiality, non-repudiation**
- **Safety Assurance (SfA)**
  - **Risk to the safety of people & equipment**
- **Software Assurance (SwA)**
  - **Free of exploitable vulnerabilities, functions to specification**
- **System Assurance (SysA)**
  - **All applicable safety, security, reliability, regulatory etc goals are met**

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OMG Systems Assurance specifications

- **Common framework for analysis & exchange of information about system assurance and trustworthiness, including ...**
- **Structured Assurance Case Metamodel**
  - **For representing auditable claims, arguments & evidence that system satisfies particular requirements**
- **Automated Source Code Security Measure**
  - **Measured by detecting most-exploited source-code weaknesses (e.g. SQL Injection 1st, Buffer overflow 3rd)**
- **Dependability Assurance Framework for Safety-Sensitive Consumer Devices**
  - **Methodology for dependability argumentation for safety-sensitive consumer devices with embedded software**

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SysML

- **Graphical modelling language for specifying, analyzing, designing & verifying complex systems that may include hardware, software, information, personnel, procedures**
  - **Provides means to precisely model large, complex systems-of-systems, from requirements to acceptance**
- **Aids communication across engineering disciplines**
  - **Co-developed with International Council on Systems Engineering (INCOSE)**
  - **Widespread tool support**
  - **Mature, widely-used**

OMG SYSTEMS MODELING LANGUAGE™

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Ontology Definition Metamodel

- **IIoT systems could generate huge amounts of data**
  - **New data categories may be added as systems evolve ...**
  - **... with new units, meanings & relationships to each other**
  - **Hard-wiring static assumptions about data being created, analysed and used would limiting system adaptability**

- **Ontology Definition Metamodel (ODM) provides tools to categorise data & represent complex, evolving relationships**
  - **Enables reasoning about data types & relationships not foreseen at design time**
  - **A vital foundation for data analytics**

ODM™
Ontology Definition Metamodel™

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Interaction Flow Modelling Language (IFML)

- **User interface design will make or break IIoT systems**
  - **Much IIoT debate centres on machine/machine interactions**
  - **... but data visualisation & analysis put humans in the loop**
  - **Must achieve seamless man-machine interface that minimises unnecessary input & undesired output**

- **IFML supports abstract design of user's interaction with system**
  - **Independent of presentation technology**
  - **Focussed on structure of user interactions**
  - **No definition of graphics or styles**

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Data Distribution Service

- **Integration "glue" for IIoT applications spanning data centres to edge sensors**
  - **Creates virtual, decentralised global data space abstraction**
  - **Excellent performance with real-time guarantees**
  - **Proven-interoperable products from multiple vendors**
  - **Available for safety-critical systems to DO-178C Level A**
  - **Integrated security framework**
  - **Fine-grained access control**
  - **Highly scalable**
  - **Proven in multiple mission-critical applications**

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DDS controls Grand Coulee Dam

Largest US hydro-electric plant (6.8 GW)

Fastest-responding major power source on US Western Grid

Kennedy Space Centre

NASA Orion Launch Control System

First Launch 5 Dec 2014

DDS-based SCADA system

300 k points @ 400k msgs/sec

ULA

Summary: What IoT standards do we need?

- **Obviously, for networking together IoT devices**
  - **To allow multiple vendors' products to work together with minimum (re-)configuration**
- ***In Addition* we need tools, training & (yes) standards for:**
  - **Specifying, analysing, designing, verifying complex systems**
  - **Dependability Assurance**
  - **Threat & risk modelling**
  - **Measuring Source Code security/robustness**
  - **... other Safety, Security & Resilience issues**
- **(And by the way, OMG publishes standards in all these areas)**

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For more information

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Thank You!

Questions?

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