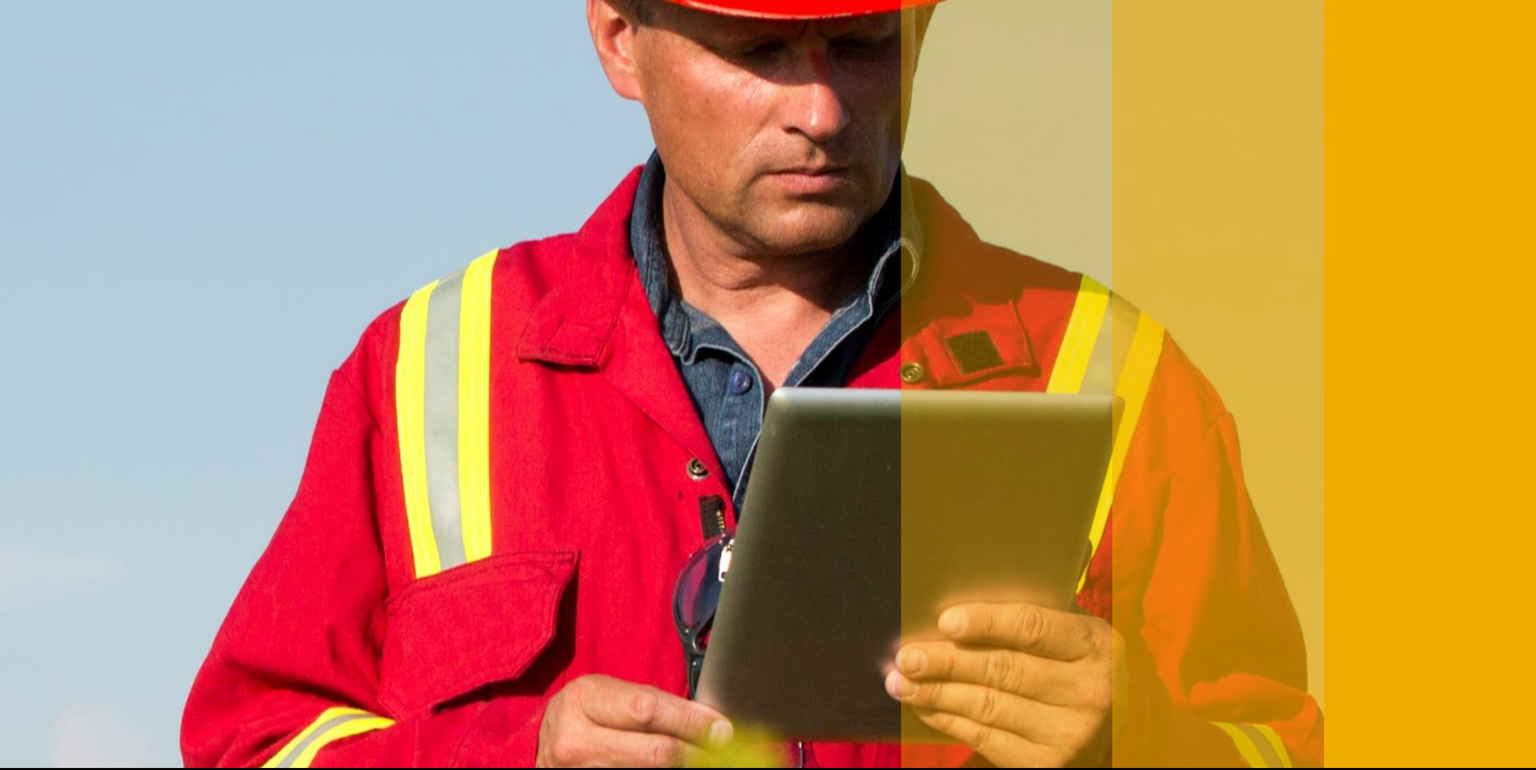


Digital Oil and Gas

Volume II
The Industrial Internet of Things

SAP Run Simple

Digital Oil and Gas

Volume II
The Industrial Internet of Things

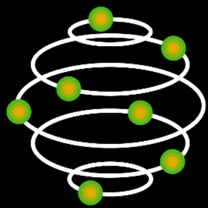
Commodity prices remain low and are not expected to dramatically increase

Oil and gas organizations must sustainably reduce cost structures

The industry is facing disruption from multiple sources – regulation, alternative energy, global demographics and more

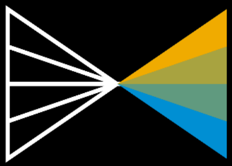
The industry has already extracted as much value as possible from three main areas of cost

1. Reducing organizational headcount
2. Increasing pressure on supplier pricing
3. Redesigning processes for incremental efficiencies



Connecting things to outcomes with the industrial internet of things

Improving – and automating – decision-making with machine learning



The next wave of innovation will not be easy - it will require the thoughtful adoption of digital technology

Enhancing efficiency and effectiveness with automation

Transforming the way transactions are performed and documented with blockchain

INTRODUCTION

The industrial internet of things is the digital networking of the physical industrial world; hardware and software come together, and these "things" lead to physical outcomes

The internet of things (IoT) is the digital networking of the physical world, allowing objects to be sensed or controlled across an existing network, leveraging software and hardware[1]. Hardware, such as sensors, can provide readings from the object. Software, such as machine learning algorithms, can be used to provide performance insight to users. Hardware, such actuators, can be used to take action automatically, based on sensor signals or software instructions.

The industrial internet of things (IIoT) is the application of IoT concepts and technologies within an industrial setting. The expected outcomes of the IIoT include improved efficiency, improved accuracy, and reduced human intervention. These outcomes imply improved economic performance and worker safety.

The "things" within IIoT can be thought of as an interconnected combination of hardware, software, data, and services[1]. The "things" can also be thought of existing within categories of connected objects, including: products, assets, fleets, infrastructure, markets, and people.

The "things" that make up the industrial internet of things are an interconnected set of software and hardware-based tools that facilitate the simplification and automation of taking action

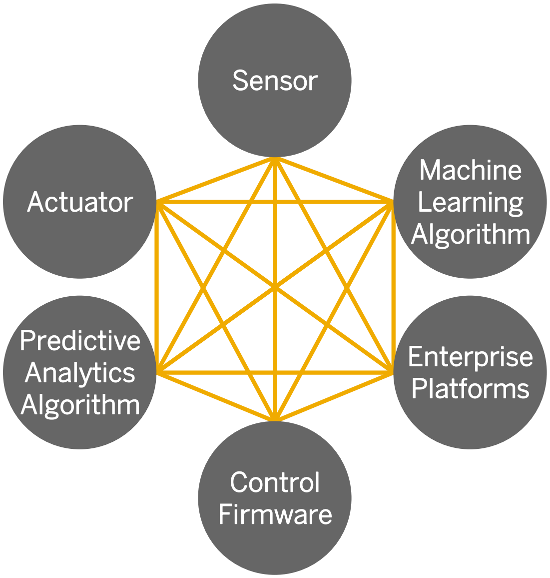


Figure 1 – Example "Things"

INTRODUCTION

The industrial internet of things creates a Things-to-Outcomes paradigm that can be augmented with automation and machine learning to accelerate and simplify process

While these definitions leave us with nearly endless use cases, from an enterprise perspective, it can be useful to consider a Things-to-Outcomes process (Figure 2). The "thing" ultimately results in an outcome.

The handoffs between these steps in the process could be human-powered, or the entire end to end process could be automated. For example: an equipment sensor sends temperature and vibration data to an analytical model which determines that rotations must be decreased in the equipment; that software sends instructions to one or more actuators and/or control systems that alter the rotations appropriately, which decreases temperature and vibration. This can be further elevated by introducing learning algorithms that become smarter with each pass.

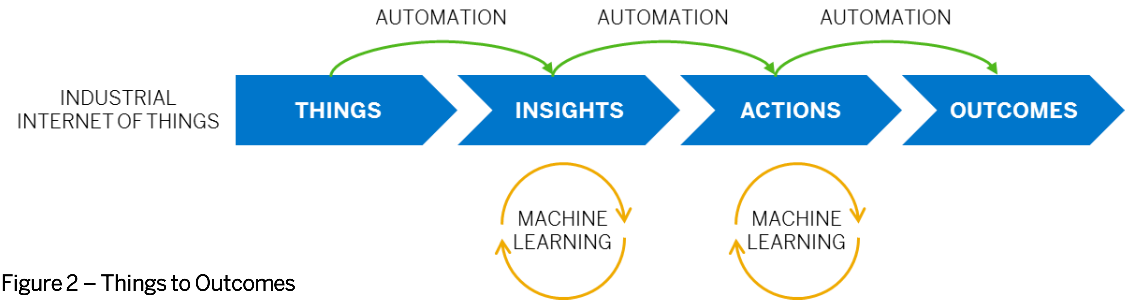


Figure 2 – Things to Outcomes

With the extensive inventory of equipment and assets throughout the oil and gas value chain, it should come as no surprised to anyone that the IIoT offers a wealth of opportunity to the industry. In fact, the oil and gas industry was one of the first to actually adopt sensor technology in the field. However, that early adoption has not resulting in as thorough penetration as might be expected: GE estimates that only 3 to 5 percent of all oil and gas assets are connected, and of all data collected, 97 percent is never used[2]

All of this is now possible thanks to pervasive connectivity (supported by technologies like cloud) and a step-change is available computing power to process the large volume of data. It seems clear, then, that there is opportunity to be had, and work to be done to capture the potential benefits available to the industry.

BUSINESS CHALLENGES

The industrial internet of things offers a set of tools that will help the oil and gas industry better understand organizational performance, ultimately supporting cost reduction

With benchmark oil prices under pressure and a relatively flat forward curve (as of March, 2017[3]), every organization in the industry is compelled to find ways to sustainably reduce their cost structures. The oil and gas industry is built upon an extensive infrastructure of complex, diverse, and geographically disparate facilities and pieces of equipment. As a result, understanding how every component within the organization is performing (to find areas for improvement) is a non-trivial task.

Here are eight challenges in understanding performance that the IIoT helps to solve:

1. Understanding which components (i.e., equipment and assets, individually and classes) are performing well, and which ones are not
2. Understanding relative performance within a component class
3. Automating repeatable, low value tasks (e.g., when a potential failure is identified, automatically create an inspection work order and assign it)
4. Increasing maintenance maturity to move from time and usage based approaches to condition and predictive based approaches (where appropriate)
5. Combining data from multiple places to drive more valuable insights (e.g., sensor data and ERP data together to make work order prioritization decisions)
6. Understanding human vitals and general health in potentially dangerous environments, in real time
7. Using sensors, cameras, or other “things” (e.g., drones) to perform inspections in dangerous locations, increasing safety
8. Tracking equipment and inventory at a site, facility, or any geo-fenced area

POTENTIAL VALUE

The industrial internet of things can potentially improve output, reduce costs, improve asset life, and improve safety

The IIoT helps organizations deliver efficiency and effectiveness across the enterprise, which ultimately offer the opportunity for cost reduction.

SIMPLIFIED AND AUTOMATED ACTIONS

IMPROVED ASSET EFFICIENCY	IMPROVED HUMAN EFFICIENCY	IMPROVED PROCEESS EFFICIENCY	IMPROVED MAINTENANCE EFFECTIVENESS	IMPROVED SAFETY
Corrective Action • Improving efficiency of assets by understanding performance and taking action to correct where required, increasing output and reducing costs	Optimize Work • Improving efficiency of humans by understanding behaviours and patterns, and taking action to improve where possible (e.g., move inventory stores closer to work), increasing output and reducing costs	Adjust Work • Improve process efficiency by understanding performance in real time, and adjust appropriately to optimize outcomes, reducing costs	Mature Maintenance • Reduce maintenance costs and effort by performing maintenance when it is required (based on condition) as opposed to time or use, reducing cost and increasing asset life	Reduce Risk • Improve safety by using non-human means in potentially dangerous environments, and understanding human health in strenuous environments, reducing incidents and improving employee satisfaction

Figure 3 – The Value of the IIoT

Sensor data can be used to understand hauler performance, maintenance schedules, and road conditions for remote sites

HEAVY HAULER POTHOLE ANALYTICS

BUSINESS CHALLENGE

Understand condition of heavy hauler hydraulic equipment; understand road quality over entire route; action hauler and road maintenance as required

SOLUTION DESCRIPTION

- Sensor data from hauler hydraulic system is sent to analytics platform in real time
- Maintenance algorithm compares degree and frequency of force to models projecting failure
- When accumulated force is estimated to be sufficient to potentially cause failure, a work order notification is created within the ERP, to be actioned by maintenance schedulers
- Geo-mapping algorithm compares hauler data to other haulers, based on geo-location and attempts to determine road condition
- Where patterns form regarding continuously harsh conditions across haulers and drivers, a work order notification is created within the ERP, to be actioned by maintenance schedulers
- Analytics capabilities allow for comparison of performance by driver, to identify if certain drivers are harder on equipment than others
- Analytics capabilities allow for seasonality analytics to confirm hypothesis about which times of day and year are hardest on equipment, for potential optimization

POTENTIAL VALUE

- Decreased / optimized maintenance costs on haulers and roads
- Decreased downtime on haulers
- Increased safety

Maintenance costs can be optimized by understanding the signals being sent by remote equipment, and anticipating required maintenance, as opposed to time-based inspections

REMOTE PUMP INSPECTION AND FAILURE PREDICTION

BUSINESS CHALLENGE

Pumps and other equipment in remote locations that require regular inspection; sending resources is inefficient and expensive

SOLUTION DESCRIPTION

- Sensors capture performance measurements and send periodic updates to cloud based analytics platform for processing
- Analytics platform performs condition-based and predictive maintenance checks against algorithm; if work is deemed necessary, work order notification is created within ERP for maintenance schedulers
- Cameras at site capture equipment performance, and using edge computing device compare performance parameters to known optimal operating ranges
- If performance is unacceptable, work order notification is created (via cloud connectivity) within ERP for maintenance schedulers
- Cameras at site capture gates, and using edge computing device check for physical security breeches
- If breaches are detected, notifications are created and actioned

POTENTIAL VALUE

- Decreased / optimized maintenance costs
- Reduced inspections costs
- Improved security

Understanding how workers actually travel and work in a facility can help to optimize design, reducing work efforts and increasing satisfaction

FACILITY LOGISTICS OPTIMIZATION

BUSINESS CHALLENGE

Optimize facility layout by understanding how workers are required to move about the facility to complete tasks

SOLUTION DESCRIPTION

- Sensors included as a component of PPE track the location of workers throughout the facility
- Analytics platform is used to cross reference geo-location of worker with work orders being completed
- Analysis highlights non-productive time (e.g., travel time, wait time) in work order completion and aggregates results for similar work for human review
- Review identifies tasks within process with potential for improvement through facility restructuring
- Sensors also contain CO2 warning sensor and fall sensor

POTENTIAL VALUE

- Decreased process duration
- Increased worker satisfaction
- Increased safety

Maintenance strategies can now include increase automation to eliminate manual effort in scheduling work and obtaining spares parts from suppliers

PREDICTIVE MAINTENANCE WITH SCHEDULING AND INVENTORY MANAGEMENT

BUSINESS CHALLENGE

Improve efficiency and lower cost of equipment maintenance by predicting failure and scheduling work tasks that take into account resource capability and schedules, along with inventory availability

SOLUTION DESCRIPTION

- Sensor data from equipment is captured by predictive maintenance platform and analyzed for potential failure
- Potential failure is identified and exceeds allowable probability threshold
- Criticality is calculated based on equipment criticality levels, downside financial risk, and end to end facility impact of failure
- Platform cross references failure with required work tasks and determines potential resources for work completion, based on workforce capability repository for employee and contractor capabilities
- With criticality and potential resources, work order timing is determined based on relative priority of work and availability of resources; proposals provided to approving maintenance manager
- Platform identifies required parts inventory for repair, checks stock, determines potential sourcing options through procurement business network aligned to schedule; proposals provided to approving maintenance manager

POTENTIAL VALUE

- Improved maintenance process efficiency through automation
- Lowered maintenance costs (fewer unnecessary repairs)
- Decreased downtime (prioritized scheduling, inventory available with scheduled work)

FOUNDATIONAL TECHNOLOGY

To leverage the industrial internet of things, organizations need foundational technology in place supporting advanced analytical capabilities

To fully take advantage of the IIoT, organizations must have a strong foundation in place that establishes the enterprise landscape, and provides the tools and structures required for advanced technology applications. There are eight elements to this foundation:

MASTER DATA MANAGEMENT	ENTERPRISE DIGITAL CORE	REAL TIME TRANSACTION PLATFORM	REAL TIME ANALYTICAL PLATFORM
Simplified, standardized, complete, and cleansed data; master data governance structure	Single source of enterprise truth for all transactions related to finance, supply chain, logistics, maintenance, and projects	Transactional platform must have the computational power to allow for real time posting and analytics (no batch jobs)	Analytical platform must have the computational power to allow for real time replication of relevant data, with appropriate data tiering
WORKFORCE MANAGEMENT PLATFORM	**STANDARD PROCESSES AND TOOLS**	**ENTERPRISE CLOUD STRATEGY**	**ENTERPRISE INTEGRATION STRATEGY**
Single platform to capture hire to retire processes for both employees and contractors	Standardization across business units allows for scalability of technology solutions, simplifying deployment and maximizing value	A clearly defined cloud strategy helps make deployment decisions easier, avoiding the distraction of having to discuss it for each selected technology	A clear approach to integration can simplify

In addition to these foundational technologies, the IIoT relies on equipment sensors that have been installed and are streaming data that can be captured by other systems. These systems must have the processing capability to handle the volume of data being streamed, and have established algorithms and models to interpret their results. Of course, the network of connected things is potentially vast (see Figure 4 for some examples).

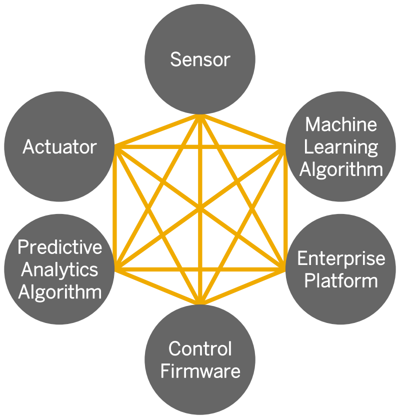


Figure 4 – Example Internet of Things

There are immediate, actionable steps you can take to start exploring the industrial internet of things

In general, any technology-enabled transformation must follow a clear, intentional process:

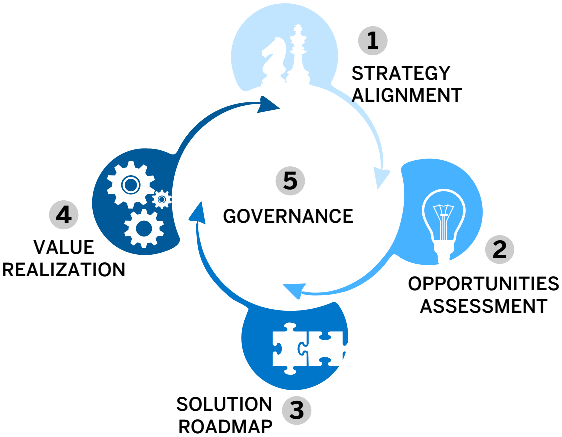


Figure 5 – Technology Transformation Methodology

1. **Strategy Alignment:** Translate corporate priorities and initiatives into technology priorities
2. **Opportunities Assessment:** Explore opportunities based on strategic initiatives and prioritize based on value
3. **Solution Roadmap:** Document end-state solution, qualitative and quantitative benefits, and strategic roadmap
4. **Value Realization:** Measure value delivered through transformation
5. **Governance:** Maximize and accelerate value from investments with governance based on executive engagement, value delivery and continuous innovation

Here is how you can get started with the IIoT:

1. Identify potential use cases by finding sensors that provide visibility into equipment performance (leverage your partners and vendors for help!)
2. For each use case, understand the potential value to either resolving the problem, or exploring the opportunity
3. Prioritize one use case to begin with (target something that is large enough to deliver value, but small enough to get your arms around – you are probably targeting $2M / year in value, not $200M / year)
4. Narrow your use case scope (e.g., by equipment type, or geographic region), and find an executive sponsor who is willing to support your effort and engage to unlock those annual benefits
5. Unlock the potential value by: defining success criteria, proving the case with a Proof of Concept, and once successful, deploying across the organization

REFERENCES

1. Wikipedia (2017, June). Internet of Things [Online]. Available: https://en.wikipedia.org/wiki/Internet_of_things
2. D.Wethe (2017, April 18) Big Oil's Rejection of Silicon Valley Is Finally Coming to End [Online]. Available: http://boereport.com/2017/04/18/big-oils-rejection-of-silicon-valley-is-finally-coming-to-end
3. CME Group (2017, March) Crude Oil Futures Quotes [Online]. Available: http://www.cmegroup.com/trading/energy/crude-oil/light-sweet-crude.html

IDEATION CENTRE AT SAP CANADA

The Ideation Centre's mission is to help Canadian leaders of business, academia, government and non-government organizations develop a deeper understanding of the digital forces driving the economy today. Ideation Centre members strive to bring forward made-in-Canada fact-based arguments that challenge decision makers to think about the potential of organizational shifts that were not possible in the past.

The Ideation Centre is fueled by thought leaders from the Industry Value Engineering team at SAP Canada. This diverse team of industry and value advisors helps organizations of all sizes and industries take advantage of technological innovations to create incremental economic value by adopting new business models and optimizing business processes, from the back office to the boardroom, farm to storefront, mine to operating room.

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