IoT Analytics in Manufacturing:

HOW TO GET VALUE QUICKLY FROM YOUR IoT PROJECTS

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I. INTRODUCTION – LEADING THE WAY IN ADOPTION AND RESULTS

In a recent survey by Tata Communications on IoT initiatives, Industrial manufacturers reported a 29% increase in revenue from the previous year and predicted IoT initiatives will increase revenue faster than any other segment from 2015 to 2018.

Of the 13 industries included in the study, industrial manufacturing is by far the most optimistic with regard to IoT's potential to drive increased revenues from 2015 until 2018.

The operations of a modern manufacturing operation involve thousands of sensors and machines that collect massive amounts of data. Leveraging this relevant "dark data" to boost business performance is the obvious goal.

But how and where to begin are difficult questions to answer. Fortunately, new ideas and tools in analytics for IoT are coming to bear that can help manufacturers make sense of it all and make decisions to improve their operational efficiency and overall business results. Let's review some of the major use cases for Analytics in IoT as a start to answering the where and how questions.

II. THE DATA OPPORTUNITY – INTEGRATING ALL THE SOURCES

Among the myriad challenges associated with gaining value in IoT applications, getting intelligent and actionable insights from the tsunami of data is the most difficult. It is intuitive that this dark data can yield major new insights for business decisions and generating value.

Integrating all the data and putting it in the proper context is required in order to yield insights for business decisions and generating value. And in manufacturing, there is a high volume and range of data that is collected and processed. The comprehensive chart below, Figure 1, from a recent Intel whitepaper lists a set of industry types for manufacturers and then details the various types of data required in that segment.

MANUFACTURING INDUSTRIES EXAMPLES	REAL-TIME, SEMI-STRUCTURED DATA	UNSTRUCTURED DATA	STRUCTURED DATA
Semiconductor **Electronics** **Solar** **Machinery** **Energy** **Automobiles** **Aerospace** **Chemical and Pharma** **Metalworking** **Food and Beverage** **Pulp and Paper** **Clothings and Textiles** **Furniture**	Machine builder standards like SECS/ GEM, EDA or custom-based on COM, XML Sensors (vibration, pressure, valve, and acoustics), Relays RFID Direct from PLCs, Motor and drives, Direct from motion controlers, robotic arm Manufacturing historians (time series data structures)	Operator shift reports Machine logs Error logs Texts Vision images Audio/Video Manufacturing collaboration social platforms	RDBMS databases NoSQL* Enterprise data warehouse Files stored in manufacturing PCs Spreadsheets

Figure 1: Manufacturing Data Examples, Source: Intel

Furthermore, this listing is only a high level outline by type of data, not even specific systems. In short, the data collection and processing needs in the IoT environment for manufacturing are enormous.

Analyzing and making sense of all that data can be daunting:

- The first key step is acquiring and intelligently integrating all the necessary data from the multitude of sources in a typical manufacturing environment. Manufacturing by its very nature is an activity requiring real-time monitoring and action. The irony of billions of connected devices is that these traditional demands actually go up in the IoT era. Opportunities and challenges go hand in hand.
- Next, all the data must be analyzed and put into context for operational decision makers.

Finally, manufacturing organizations need to be able to gain the insights AND take timely actions on the data that is presented to them to achieve better business outcomes.

So the two key questions for manufacturers are:

- How to begin assessing the opportunities to apply analytics in their IoT factory environments?
- Where in their complex operations should they begin?

III. USE CASES AND APPLICATIONS

The breadth of data in manufacturing scenarios means that there are a number of potential areas of leverage to gain significant business value. Sorting through these opportunities to determine priorities itself requires some analysis and study.

In a recent survey in the Economist, Figure 2 below summarizes the use cases and applications where the respondents thought large volumes of IoT data would yield significant gains for their business:

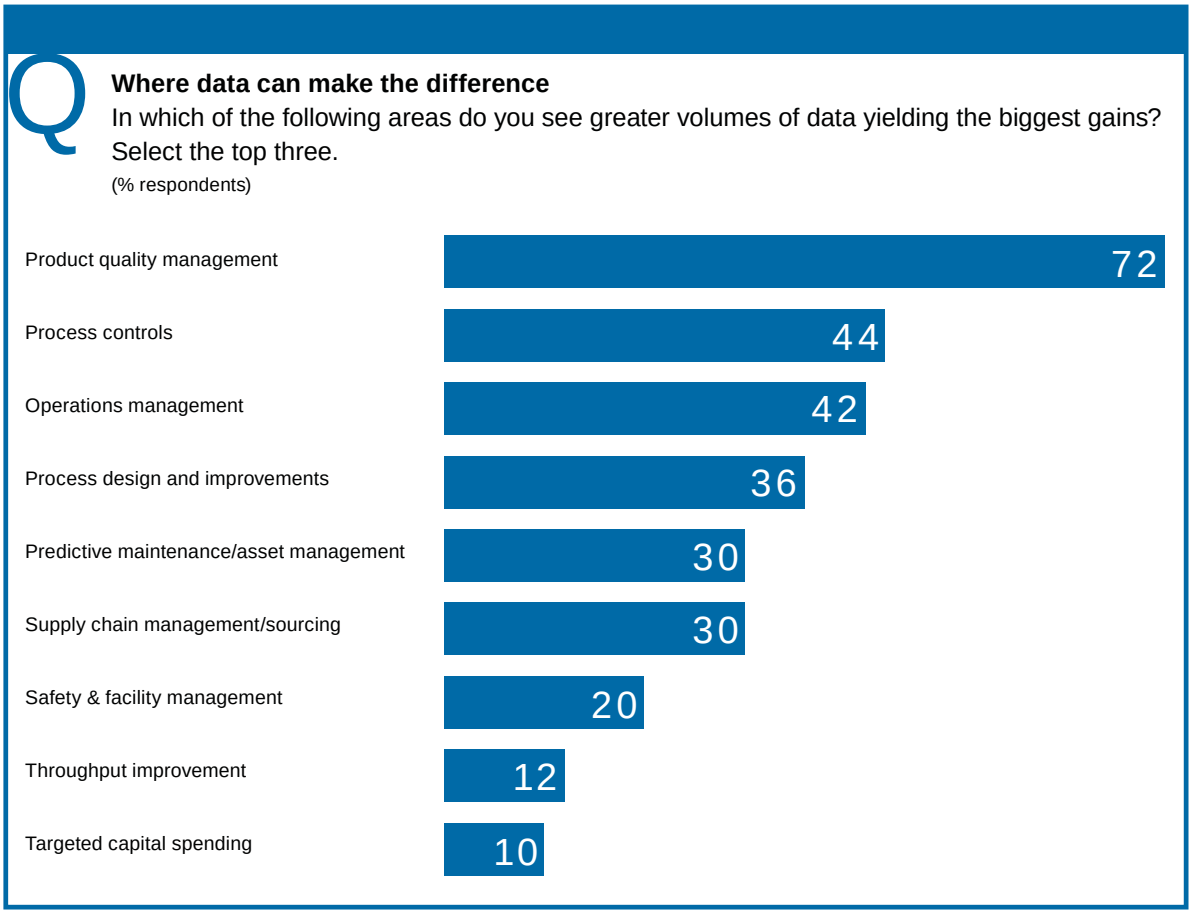


Figure 2: Use Cases in Manufacturing, Source: Economist

This data leads to a discussion of a few applications that are good candidates when searching for strong return on investment on your IoT analytics projects in manufacturing. While the appropriate first step will vary for individual companies, three of the most popular and impactful applications include:

a) Predictive Maintenance

Predictive maintenance that ensures minimum unplanned downtime is critical to maximizing return on equipment investments. IoT sensors on critical assembly equipment can deliver data in real-time that enable managers to make decisions rapidly and trigger actions to maintain production lines at maximum capacity.

Preventing hiccups of any type in a manufacturing process is crucial. Thus, systems that can predict and suggest preventative actions BEFORE anything happens to disrupt production are very valuable.

b) Operating Efficiency

Ensuring maximum throughput through an operating line is another area where IoT analytics applications can add significant value. Complex assembly operations rely on a reliable stream of sub-components and a consistent supply chain flow. IoT sensors and devices can provide early indicators of supply chain imbalances.

Analyzing this data flow can yield many points of insights and potential actions for streamlining the flow of components, processes, and human resources applied to a particular production application.

Carefully balancing component supply with operational throughput can reduce excess inventory, accelerate the assembly process, and reduce capital requirements. All of these benefits deliver increased profits and improved customer service.

c) Asset Utilization

The devices and machines on a typical manufacturing line in today's environments are major financial assets for any manufacturing organization.

The ROI on these investments is often the difference between success and failure – sometimes more than the economics of the product itself.

Manufacturers that have superior processes and asset utilization can gain competitive advantage with pricing power and flexibility that their less efficient competitors lack. IoT sensors and systems are key tools for companies looking to lead in maximizing asset utilization in both discrete and process manufacturing.

IV. MATURITY MODEL FOR ANALYTICS IN MANUFACTURING

In addition to the most common use cases above, there are many other use cases of various types in a typical manufacturing environment. It is, therefore, useful to create a framework or 'maturity model' of the various use cases to provide some context and prioritization for them.

Gartner did a good job in a recent research paper defining a maturity model for use cases around analytics in manufacturing. As shown in Figure 3 below from their report, analytics can be broken down into a four part framework.

	Descriptive	Diagnostic	Predictive	Prescriptive
	Monitor and Report Behavior	**Understand and Control Behavior**	**Manage**	**Optimize**
Questions to Be Answered	What happened? How is the process performing now?	Why did it happen? Which production units are not performing?	What will happen? When will the process fail?	What should I do? How can we do it better more often?
Decision Support	Batch, offline decisions	Pockets of fact-based decisions, rule-based	Operationalized predictive models in applications and pervasive fact-based decision making	Human-augmented, collaborative; real-time embedded, automated decision optimization
Use Cases	• Cycle times/operating efficiencies • Machine breakdowns/ unplanned downtime • Alerts/alarms/events • Error proofing	• Root cause/failure analysis • Target production costs/ Variances • Schedule changes • Capacity availability and utilization	• Simulation of adverse events ("what if" versus "perfect day") • Line flexibility simulations • Predictive maintenance	• Where to produce and when • How to introduce BOM/specification changes/alternatives • Product testing

Figure 3: Analytics Continuum for Manufacturing Operations

Each of the four types of analytics has a set of key questions, decision support foci, and use cases associated with it. All of these analytics types and use cases have strong value potential and are useful in its own right. Nevertheless, while this outline of types and cases is useful, it still does not fully answer the question asked at the outset of this paper:

Question: How to Get Value Quickly in IoT in Manufacturing?

V. THE ANALYTICS VALUE CHAIN – HOW TO GET VALUE QUICKLY

The irony of the IoT era for manufacturers is that while it offers great promise because of the ability to leverage the high volume of data and interactions, it is also very complex and difficult to make sense of it all and take meaningful actions that will have an economic impact. The applications and use cases outlined above offer strong potential for application of analytics, but a methodology is needed to sort through and prioritize the projects.

To address these challenges and meet the vision of a Connected and Intelligent Manufacturer, **there is a need to execute analytics in real-time across the analytics value chain** (streaming, historical, predictive, and prescriptive) with relevant contextual and situational data that addresses the critical last step for timely outcomes.

Understanding and taking advantage of the value chain is the answer to our "How to get value quickly" question in the title of this paper. Let's step through the process in Figure 4 below.

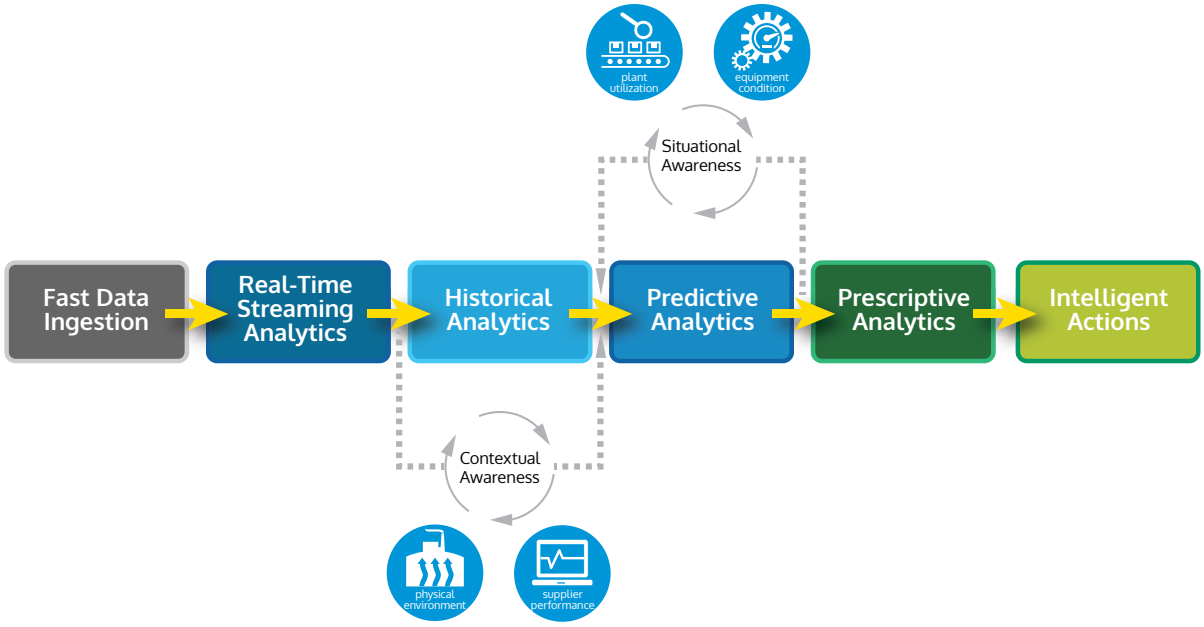


Figure 4: Analytics Value Chain in Manufacturing

1. **Fast Data Ingestion** - Ingesting data at speed and volume throughout the factory sets the stage for additional processing.
2. **Real-Time Streaming Analytics** - Real-time Streaming Analytics processes incoming streams of data from sensors and devices all around the factory environment.
3. **Historical Analytics** - This refined data is then correlated with contextual and historical data to provide a baseline for advanced analytics. Contextual data can include information like the physical environment of the factory or historical performance of suppliers.
4. **Predictive Analytics** - The next step is to predict failures, anomalies, or patterns using predictive analytics that are based on machine learning over situational data such as external events like the current plant utilization rate or the condition of production equipment.
5. **Prescriptive Analytics & Intelligent Actions** - The final steps in the analytics value chain are to apply prescriptive analytics and intelligent actions to execute the next best actions to take. This next best action could be a wide variety of actions associated with lowering risks, addressing an outage on the assembly line, or other timely actions that enable more efficient assembly line operations.

As shown in the final figure below, it is this final step that creates the greatest value.

Figure 5: Business Value with the Vitria IoT Analytics Platform

The increasing value chain shows how each step in the process refines the data and adds more value and context. The important point is that specific actions based on a rich understanding of history and context must be taken NOW in order to capture that value.

VI. THE NEW SALES ARENA FOR MANUFACTURERS IN IoT

As manufacturers seek to implement new analytics applications and accelerate along the analytics value chain in IoT, a new sales model is emerging for them. This new model will be very different than the traditional manufacturing value chain.

a) Pre-IoT Sales/Channel Model

The traditional model typically works as follows:

- Manufacturer specifies a product and chooses suppliers for the raw materials and equipment.
- Goods arrive, and are fed into an assembly line or other process for production of the final product.
- Goods are shipped out to various distribution and channels that in turn sell and ship the product to wholesalers and retailers in various forms.
- Customers buy the final product from these channels.

b) New IoT Model

In the new IoT era, these traditional one way channels will no longer apply. The huge volume of data - along with new analytic techniques and technology – have made this model obsolete. In the emerging era of IoT with robust real-time analytics, the fundamental nature of business relationships will change.

Bosch is a manufacturer that understands this trend very well, and has written extensively on the new "sales arena" that is emerging along these lines. This new model, shown in Figure 6 below, will change buying and selling relationships in a fundamental way.

THE NEW 'SALES ARENA' IN THE INTERNET OF THINGS

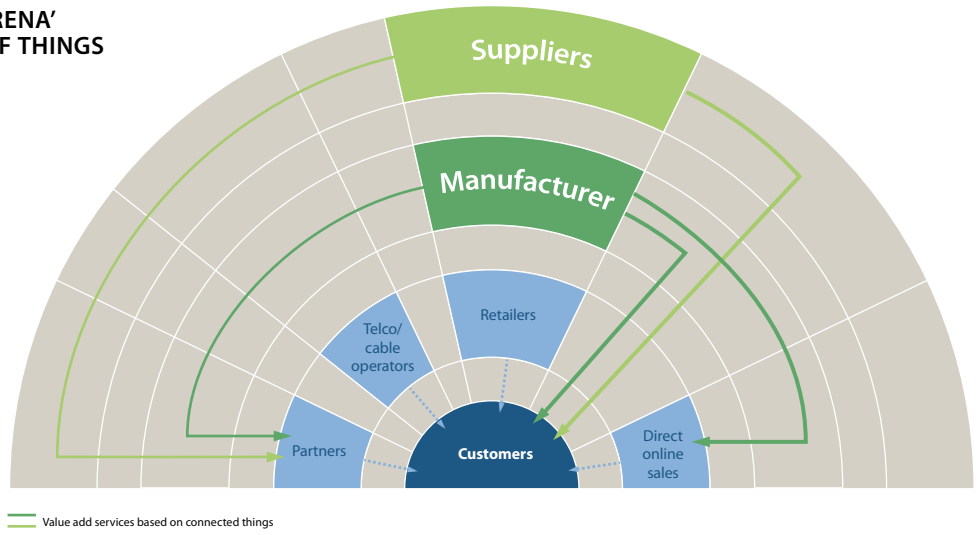


Figure 6: The New Sales Arena for Manufacturers in IoT*

- With the functional changes that are part of IoT, manufacturers now have a number of direct routes to their buyers, but this access is a double-edged sword.
- Their competition has access as well, and it is easier for their competition to address buyers than in the traditional multi-tiered model.
- This new playing field means that manufacturers need to add unique value and services to complement their products. While superior performing products remain important, they are no longer the dominant factor in buying and selling decisions.
- Value-added services – particularly those based on real-time analytics – are now the norm. Manufacturers who can take advantage of these new tools and technologies will be more competitive in both operations and customer service.

** http://blog.bosch-si.com/categories/internetofthings/2014/05/infographic-capitalizing-on-the-internet-of-things/*

VII.FINAL THOUGHTS

IoT in manufacturing offers numerous points of opportunity, but the massive data volumes and complexity make it difficult to know how to find value. By considering your organization's maturity model and using the **analytics value chain** as a guiding tool, manufacturers can pick and choose which applications to build first to capture value quickly.

Manufacturers will need to do this as the IoT era will be characterized by a new kind of sales model that will demand a nimble posture from manufacturers. The connected factory will enable direct connections to end customers that have not existed in the previous world of channels and distribution. This brings opportunity, but also a higher degree of competition for customers. Time-to-value is paramount in manufacturing and IoT analytics will be a strategic tool to deliver value.

Vitria provides an advanced analytics platform that enables rapid movement through the analytics value chain. As manufacturers seek to navigate the new sales arena and maximize business value via the value chain, they need a unified analytics platform that enables continuous iteration and innovation.

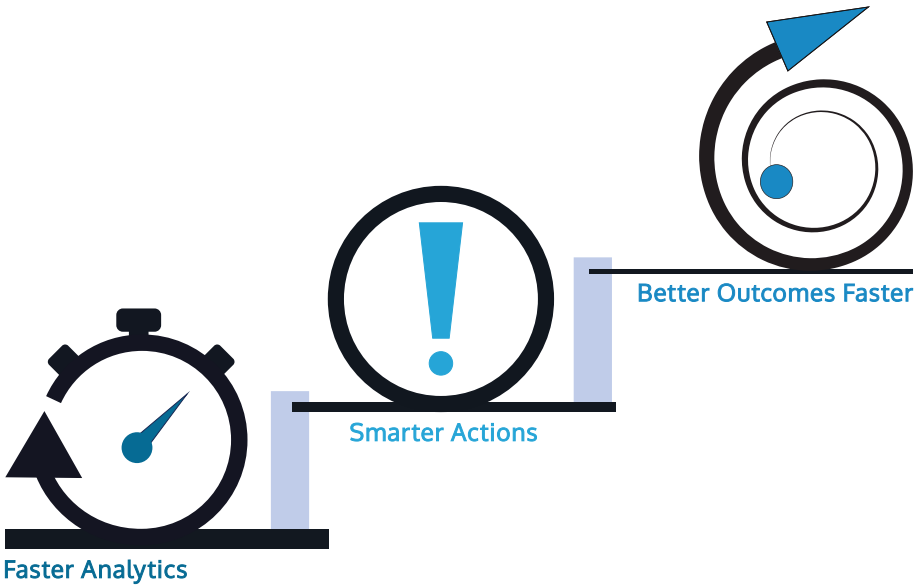
To learn more about the Vitria IoT analytics platform or request a demo, contact us today!

ABOUT VITRIA

Vitria's advanced analytics solutions empower enterprises and industrial customers to achieve better outcomes faster in their business operations.

The company was founded in 1994 and has a long history of success in streaming analytics, business process management, enterprise application integration, and operational intelligence. Vitria is also a leading player in the rapidly growing IoT (Internet of Things) analytics market. Customers include Fortune 500 companies and enterprises across a wide range of industries, including finance, manufacturing, telecommunications, utilities, retail and more. For more information, visit www.vitria.com

Contact us to learn more about how our platform can help you achieve better outcomes faster



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