Manufacturing Intelligence in the Age of Industry 4.0 and the IoT

Expanding analytic capabilities are critical to digitizing the business, optimizing costs, accelerating innovation, and surviving digital disruption

To survive digital disruption being brought by the IoT and Industry 4.0, manufacturers must apply field and customer centric analytics.

BUSINESS CHALLENGE

Historically, manufacturers were almost solely focused on reducing costs by applying automation and analytics to engineering, R&D, manufacturing operations, and quality organizations. Of primary focus in these initiatives were defect reduction through root cause analyses, statistical process monitoring and control (SPC), efficient optimal designs of experiments, and overall process optimization. Even though these strategies are still needed, they are not sufficient to ensure business survival and continuity in the age of Industry 4.0 and the IoT.

Today, it is paramount that smart manufacturers broaden their scope: Disruptive innovations in data acquisition, storage, and analytics technology have enabled an entirely new degree of automation and virtualization, promising to deliver complete 360-degree high-fidelity virtual data-driven integrated views of all operations—from suppliers and supply chains, through equipment, processes, and manufacturing practices, to final product testing and customer satisfaction.

BENEFITS

- Uncover new business opportunities, revenue streams, and monetization of assets for a sustained competitive advantage
- Automate, orchestrate, and predict product failures for preventative maintenance to prevent downtime
- Process and analyze data in real time near the point of data generation for rapid response to process anomalies

TIBCO SPOTFIRE

VISUAL ANALYTICS: EASILY EXPLORE DATA TO MAKE DECISIONS YOU CAN TRUST

TIBCO Spotfire® is self-service analytics software designed to empower every individual with fast insights and smart, data-driven decisions. Spotfire delivers the most complete set of analytics unified on a single, centrally-governed platform. It offers breakthrough visual and interactive data analysis that leverages the natural human ability to see patterns. Visualizations are automatically interconnected to each other and to the data, enabling you to quickly drill down to any level of detail needed to bring insight — and even anticipate what happens next. Spotfire lets you augment your data on-the-fly. You can add calculated columns, group and bin categories, and annotate and share benchmarks. It's fast, powerful, and easy to learn and use.

However, there are numerous new technologies and standards that must be successfully mastered and integrated, with a clear focus on actual revenue generating activities. Not only do manufacturers need to understand and predict what will happen within their plants, they need to better understand and predict how manufacturing operations and practices affect customer behavior, satisfaction, loyalty, and product demand. To predict performance and product failures, manufacturers need to create a complete line-of-sight from supplier and manufacturing data. Not only will this perspective deliver more customers with greater brand and product loyalty, but the new technologies that enable Industry 4.0 will also create entirely new business models and revenue opportunities, for example, the ability to offer remote AI-driven monitoring and preventative maintenance services.

Perhaps most of the promise and success of Industry 4.0 and IoT technologies for manufacturing depends on effective machine learning, AI, big data, and other advanced analytic technologies, comprehensively implemented to provide high-fidelity virtualization, insight, and predictability. In addition, organizations also need to understand the details of how customers use their products in the field and how products age or their reliability deteriorates. Such insights will almost always open new business opportunities to enhance the customer experience.

All of this needs to happen while becoming more transparent and adhering to regulatory requirements as they are common and increasingly relevant in most industries for managing consumer risk.

ANALYTIC OPPORTUNITIES FOR SMARTER MANUFACTURING

As manufacturers shift focus to the IoT and Industry 4.0, there are several areas of opportunity that should be considered. Addressing these areas requires a holistic approach and presents significant opportunity. A survey conducted by one analyst firm recently ranked investment in BI/Analytics the #1 priority for delivering business value[1].

SALES & MARKETING

Understand markets, predict and adapt to customer preferences.
Understanding customer behavior and product usage details is commonplace. Analytics are applied to:

- Customer segmentation
- Behavioral and demographic analysis
- Propensity to purchase and share of wallet
- Product usage patterns
- Real-time hyper-regional sales/demand trends
- Price optimization
- Customer churn and retention
- Real-time promotion via Wi-Fi and cellular networks

STREAMING ANALYTICS: RAPIDLY BUILD AUTOMATED APPLICATIONS COST EFFECTIVELY

- **TIBCO StreamBase**® is an industry-leading event processing platform for applying mathematical and relational processing to real-time data streams. It enables organizations to rapidly build and deploy event-driven applications for automated processes at a fraction of the cost and risk of alternatives.

- **TIBCO StreamBase Studio**™ is a powerful Eclipse-based integrated development environment for DevOps and other IT developers to quickly build applications and deliver fast-paced, incremental releases for streaming analytics.

- **TIBCO StreamBase LiveView**® is a multi-threaded event server that can be optimized for processing real-time streaming event data to meet your requirements. It includes tools to build features for improved performance against latency and throughput.

- **TIBCO® Live Datamart** is the first analytic data mart of its kind that processes information in motion. Built on top of the StreamBase platform, it adds business-focused operational intelligence with visualizations and alerts based on reactive queries that automatically update and push new results when data changes.

SUPPLY CHAIN

Forecast demand, optimize inventory, monitor suppliers.

Analytics has always been used in supply chain organizations for forecasting and inventory management. In the age of the IoT, we now know the position of just about everything and that requires more real-time capabilities. Analytics is used for:
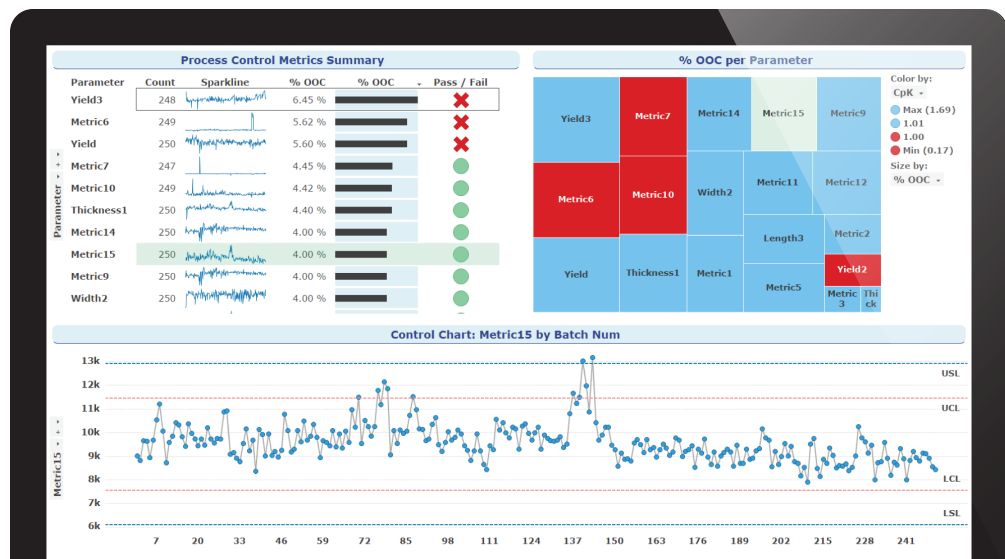
- Demand forecasting and supply chain constraints
- Resource allocation and optimization
- Product traceability
- Procurement cost and spend analysis[2]
- Order management
- Hyper-regional demand forecasting
- Real-time supplier monitoring and inventory optimization
- Routing optimization and fleet management

MANUFACTURING OPERATIONS

Real-time equipment and process monitoring, automated optimization.

One manufacturer recently said, "We have been doing IoT for 20 years, we just never called it IoT."[3] Analytics is used in manufacturing operations for:

- Automated raw material or part replenishment
- Real-time factory floor maps, equipment monitoring and control
- Intelligent model-based statistical process control
- Predictive and preventative equipment maintenance
- Process optimization
- Real-time standard operating procedure (SOP) optimization[2]
- Six Sigma initiatives
- Virtual metrology

Process control.

TIBCO STATISTICA

PRODUCT & PROCESS QUALITY

Intelligent statistical process control, yield management, and reliability analysis.
Being able to understand and demonstrate that processes are understood and in control is at the heart of initiatives using Quality by Design (QbD) and good manufacturing / documentation / security practices (GxP). Analytics are used in the following areas:

- Predictive product yield and test
- Automated in situ diagnosis of product health
- Multivariate statistical process control
- Product traceability
- Automated quality control and root cause analysis
- Advanced process control
- Continuous process verification
- Reliability analysis
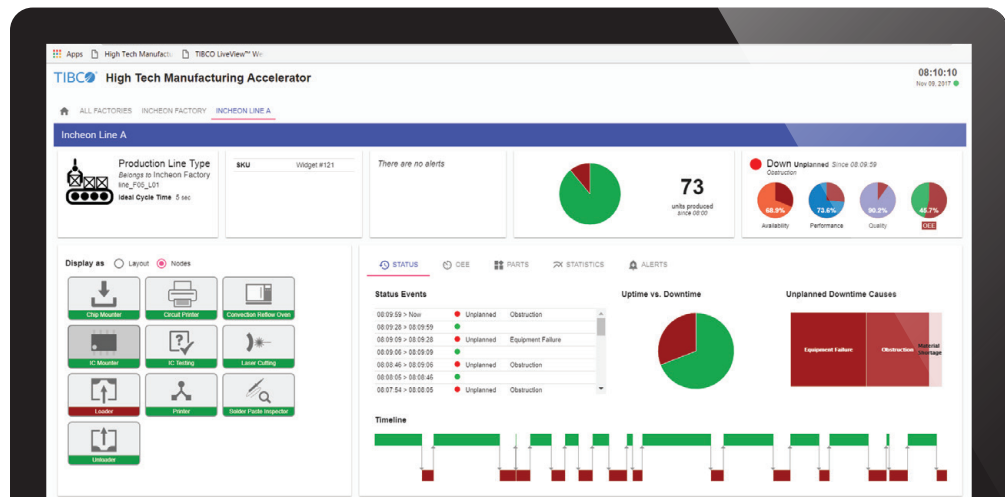
Process capability.

FIELD SERVICE & SUPPORT

Predictive maintenance, warranty analytics, and field service optimization.
Manufacturers are increasingly offering services that continuously monitor the health of products and systems in the field. These are new business opportunities that can generate significant revenue for companies. Analytics are used for:

- Automatic categorization and triage of warranty claims
- Predictive and preventative maintenance
- Field service technician routing and dispatching
- Call center routing
- Help desk queue forecasting
- Labor staff and resource optimization
- Spare part inventory optimization and routing

RESEARCH & DEVELOPMENT

Predict, simulate, and visualize successful designs and processes.

For modern manufacturers, the ability to reduce time-to-market is paramount for success. Analytics can be used in the R&D space for:

- Accelerated data integration for improved yields
- Engineering team and supplier composition analysis[3]
- Design of experiments, Bayesian response surface analysis
- Digital twins and advanced simulation
- Integrated product and client feedback during design[3]
- In situ product performance monitoring
- Pay as you go service[3]
- Product as a Service[1]
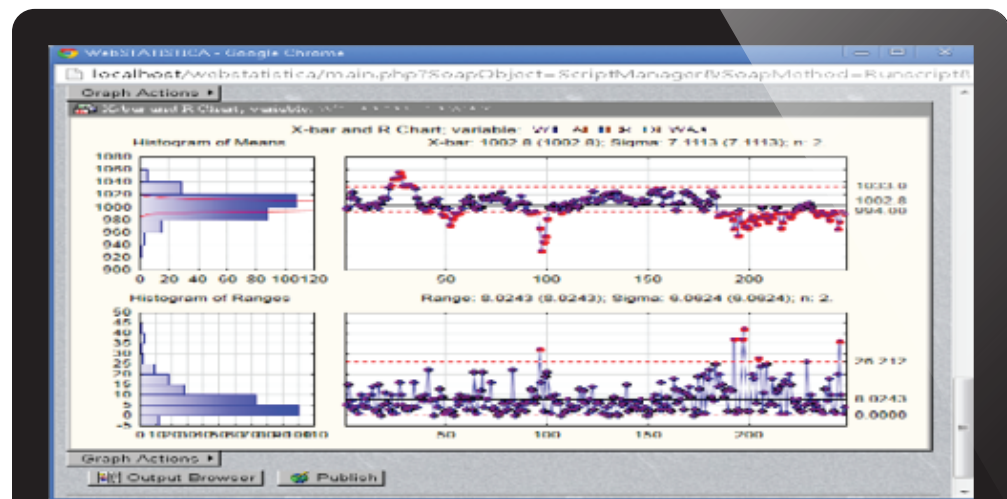
Spare part inventory optimization and routing

REGULATORY COMPLIANCE

Standardize, automate, and monitor QbD and GxP initiatives.

Being able to demonstrate to regulators that processes are understood and in control can tax even the most sophisticated of organizations. Analytics can be used for:

- Automated and validated regulatory reporting
- Complete audit trail, version control, and electronic signatures to document changes to analytic processes, procedures, and reports
- Workflow and approvals
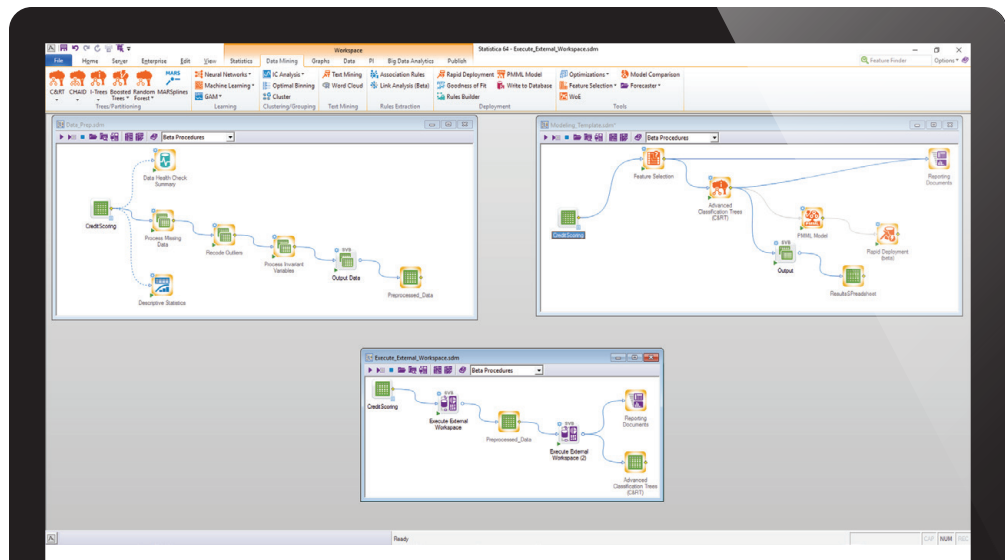
Reusable templates.

DASHBOARDS & REPORTS

Collaborate and share insights across the organization.

An organization is only as smart as the people it employs and empowers. Being able to automate the mundane and provide complete end-to-end visibility within manufacturing organizations separates the leaders from the laggards. Dashboards and reports can be infused in business processes for:

- Automated program review[3]
- Empowering engineers to respond and take action on process anomalies
- Empowering execs to understand and predict the future state of business
- Strategic reports

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1 Gartner Inc. Market Insight: What Technology Buyers in the Manufacturing and Natural Resources Industry Want in 2017. 29 March 2017.

2 McKinsey: AI The Next Digital Frontier. Intel deployed a team of data scientists in its R&D department to speed up data integration and the use of advanced analytics. Afterward, the company achieved 10 percent higher yield for integrated-circuit products compared with other players pursuing similar designs at a similar, pre-production development stage.

3 Forbes. IoT Analytics and Dell Statistica Deliver Time Compression. April 15, 2016. https://www. forbes. com/sites/gilpress/2016/04/15/iot-analytics-and-dell-statistica-deliver-time-compression/# 742c22133483

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