ARC STRATEGIES

By Sid Snitkin

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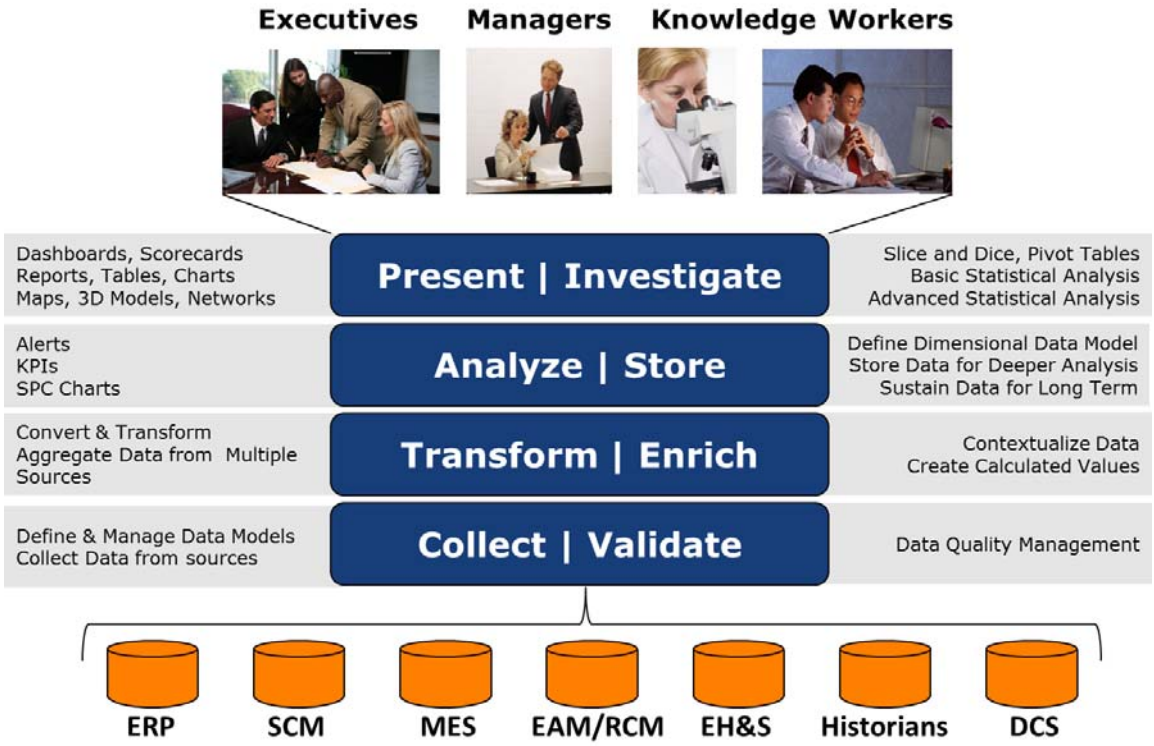
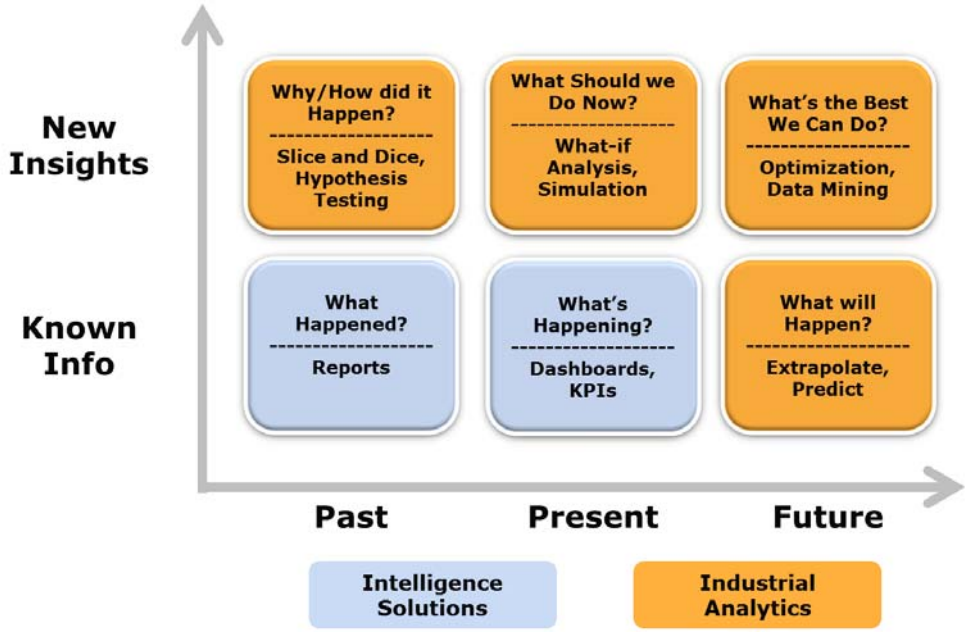


Components of an Industrial Analytics Solution



Industrial Analytics Provides More Answers

Executive Overview

Interest in analytics and business intelligence (BI) software has surged over the last few years. Leading software providers like IBM, Microsoft, Oracle, Infor, and SAP offer full analytics suites for enterprises to use to monitor, analyze, and manage a wide range of business activities. Many users report impressive benefits and ARC Advisory Group expects these to multiply as more enterprises recognize the value of Big Data and solution providers release new products that can bring analytics capabilities to the masses.

"Consistently, doing the right things, well" is a fundamental principle for the long-term success of any industrial enterprise.

Good decision making underlies each of these goals and organizations need to encourage and enable every person in the organization to make the best possible decisions regardless of their role.

That's why it's critical to select and implement the right set of industrial analytics tools.

While many industrial enterprises already use business analytics packages, their successes are primarily in customer-facing activities like sales, marketing, and product development. As a result, many question the applicability of using analytics to improve other critical, but more inward-facing industrial processes like operations, asset management, procurement, supply chain, engineering, and project management. But, in fact, most industrial companies already use some form of analytics throughout their operations. It's just that these capabilities have been deployed differently, with more limited, built-for-purpose software embedded throughout a multitude of manufacturing IT solutions.

The real question that industrial companies should be asking is whether they can justify integrating these disparate, point solutions and investing in more powerful analytics capabilities. And, if so, what is the best way to do so?

We generated this ARC Strategy Report to start a dialogue to help industrial organizations answer these questions. It begins with a discussion of the proven benefits of analytics for managing the competitive environment and provides some suggestions as to how organizations can leverage these concepts to improve internal performance across the full spectrum of activities that distinguish industrial enterprises. The report then compares the existing industrial approaches and offers recommendations on how organizations might implement an industrial analytics strategy.

The Value of Analytics Is Clear

Clearly, business analytics has become a major focus for enterprise software companies like SAP, Oracle, and IBM. These company's conferences highlight how organizations in major sectors like consumer products, financial services, the public sector, and retail are using these tools to generate significant performance improvements across key business processes:

- **Financial Management** – such as revenue and expenditure analysis; financial performance across departments and product lines and profitability analysis by product and customer channels
- **Human Resource Management** – such as compensation analysis across departments, roles, regions.; statutory compliance; and workforce development performance
- **Procurement Management** – such as spend analysis by supplier, product, and regions; supplier performance across price, delivery, and quality; and expense analysis and consolidation to leverage volume opportunities

The availability of Big Data has been a major driver of these benefits. Companies capture this through a variety of channels and use it to gain new insights into customer preferences and value chain performance:

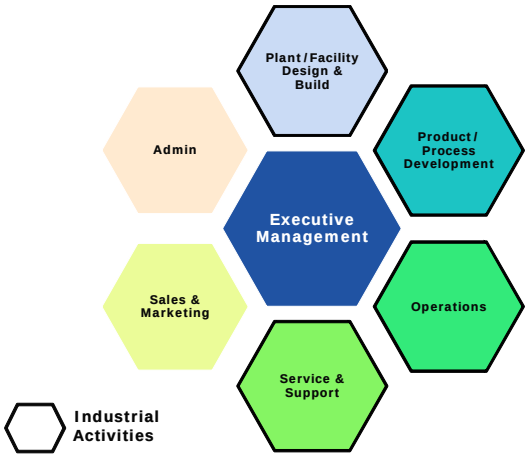
- **Point-of-Sale Data** – what people are buying and where they like to buy it
- **On-line Sales** – what products people are interested in and what features dominate their decisions
- **Social Media** – what people like/dislike and what trends are important

Investments in new technology substantiate the value that business analytics solutions generate. Many enterprises intend to expand their use of these capabilities in the future:

- **Petabyte storage systems** – to support even bigger data sets
- **In-core storage solutions** – to enable faster analysis of Big Data
- **Analytics for the Masses** – to empower even more users
- **Mobile Analytics** – to expand access to and use of analytics

The Time Has Come for Industrial Analytics

While the value is clear, most analytics solutions to date have been limited to applications such as gaining better control of factors external to the enterprise, like consumers, markets, and partners. This is where industries like financial services and retail have their biggest challenges and external transactions are their source of Big Data. Only by using this information to gain a better understanding of the playing field can they reduce business risk and enable new competitive strategies.



Industrial Enterprises Have Complex Internal Activities

Industrial enterprises are different. They actually produce things. This often involves economies of scale that drive these enterprises to acquire and operate complex, expensive facilities. Optimally managing these investments is fundamental to profitability and dominates the organization's attention.

Examples of industrial enterprises include:

- **Manufacturing** - process (refining, petrochemicals, etc.); hybrid (food & beverage, consumer packaged goods, pharma, etc.), and large-scale discrete (aerospace, automotive, etc.)
- **Raw Materials Production** - mining and upstream oil & gas
- **Utilities** - Power generation, transmission & distribution, telecommunications
- **Transportation** – air, rail, road, ships, and warehousing

While external factors play a critical role for industrial enterprises such as consumer products and electronics, many others produce commodity products in bulk and have few opportunities to leverage external Big Data for competitive advantage. This has led many industrial enterprises to discount analytics as an appropriate tool to use to drive better performance.

But industrial enterprises do have Big Data. They collect enormous quantities of information about their facilities, their industrial processes, and the products they produce. They also generate huge volumes of information to manage their extensive supply chains and the many large, complex projects

they execute on a continuing basis. But, unfortunately, most of this information remains buried in process historians and software applications such as MES/CPM, QMS, and EAM typically used to manage modern industrial facilities. Smart organizations will want to leverage this information to understand the factors that impact performance and identify the practices that can move them forward in their quest for operational excellence.

Operational data has exploded over recent years as industrial enterprises have enhanced their manufacturing IT systems to support new compliance and sustainability challenges.

Organizations have already established programs to secure this information and enable recall in the event of incidents.

The time has come to recognize that this information also has value as Big Data for internal Analytics programs.

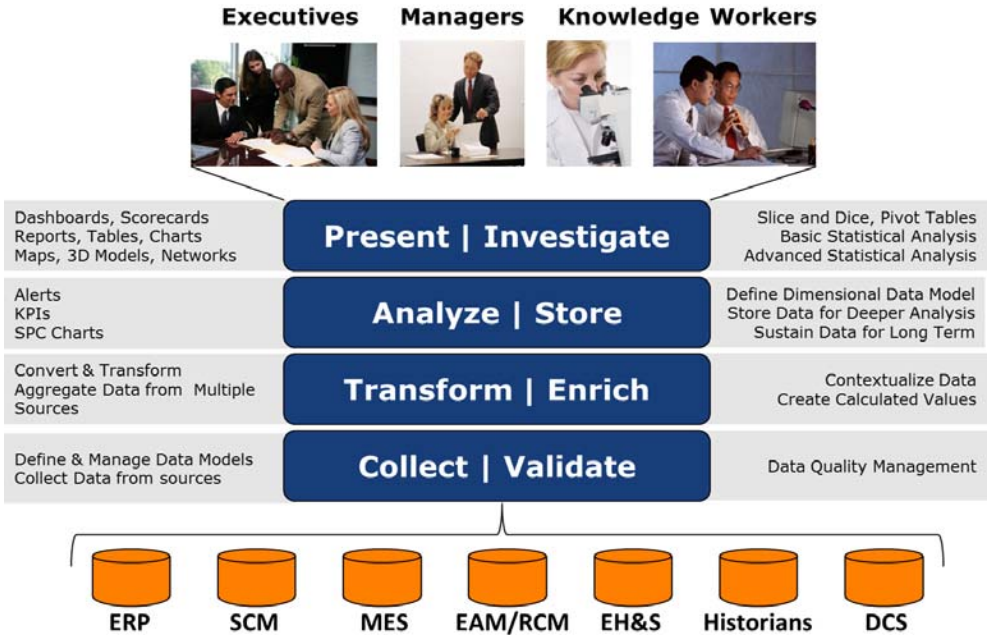
The volume of operational data has exploded in recent years as industrial enterprises have enhanced their manufacturing IT systems to support new compliance and sustainability initiatives. Organizations have already established programs to secure this information and enable recall in the event of incidents. The time has come to recognize that this information may also have value as Big Data for internal analytics programs.

Analytics is certainly not a new concept for industrial organizations. Many of the software applications used in industrial facilities already provide analytic tools to support analysis of individual operational activities. Some organizations have also invested in manufacturing/operational intelligence solutions that aggregate information from various applications and calculate KPIs for display on dashboards. These approaches all have value, but still lack the capabilities of a full industrial analytics solution to help identify the root causes of problems, quantifying key relationships, and testing new operating strategies.

Today's workers have also changed and are more prepared to use analytics capabilities in their decision making. Historically, workers had little access to data and little experience using it to make decisions, so they learned to rely upon intuition, gut feelings, and simple heuristics. Today's workers use the Web and social media to support their personal decision making and have become comfortable with data, charts, and analysis. They want the same kind of support to make better decisions at work. Enabling workers with more analytics capabilities will also motivate them to be more rational in their decision making and encourage them to explore more alternatives and identify new ways to improve their performance.

What's in an Industrial Analytics Solution?

An *industrial analytics* solution is similar, but not identical, to a business analytics solution used to support marketing and financial management. Each has different data sources and different dimensional models for the data warehouse. Users will also want different analysis tools. But the core software is the same and organizations that already have made investments in analytics software should be able to leverage them for use by key industrial departments like production, service, project and process engineering, and project management.



Industrial Analytics Includes Several Key Components

Data collection and validation forms the foundation for every analytics solution. For the industrial case, organizations will need connectors for a variety of industrial applications like production planning, SCM, MES, EAM/RCM, EH&S, plant historians, and DCSs. Many industrial organizations employ a motley set of legacy applications for these functions, so organizations should anticipate the need to connect a variety of heterogeneous applications with heterogeneous data models that need to be normalized and homogenized. As a first step, it's critical to develop a common data model. ARC recommends using a standard model such as ISA-95. Likewise, use of standard data exchange protocols like OpenO&M

can help to reduce integration costs and enable future integration across facilities.

An *industrial analytics* solution is similar, but not the same as an analytics solution used for marketing and financial management applications. There are different data sources and different dimensional models for the data warehouse. Users will also want different analysis tools. But the core software should be the same and organizations that already have investments in Analytics software should be able to leverage them for use by key industrial departments like production, service, project and process engineering, and project management.

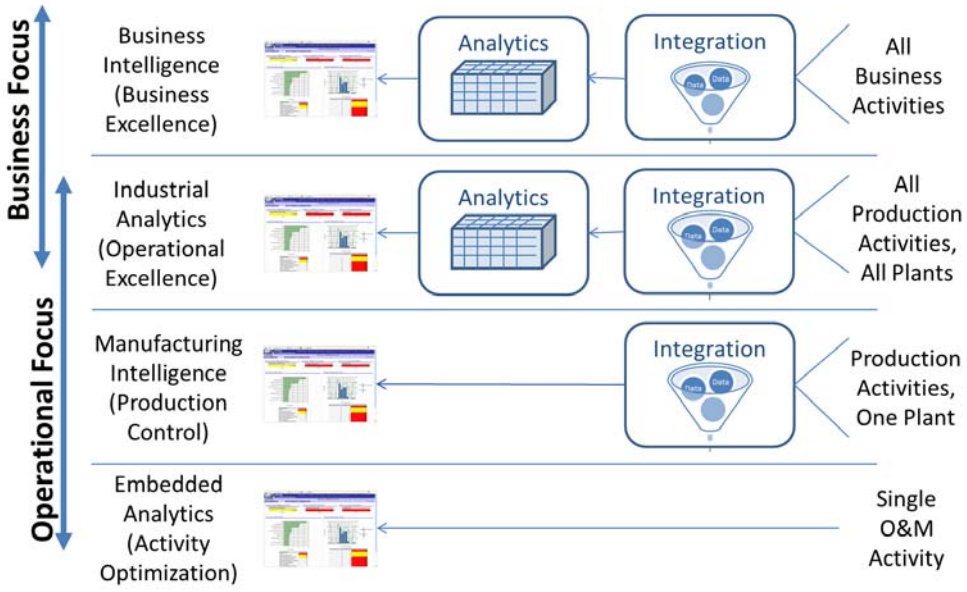
Industrial analytics solutions also need a layer of software to transform and enrich the data for analysis. Different applications use different units and definitions that must be reconciled. Many measures that are important to internal operations will also involve data from multiple applications, so information will have to be aggregated to produce new calculated values. Context is another area that must be addressed to enable full analysis of the information. For example, data from a historian may need to be associated with the product being produced to evaluate the effectiveness of different operating practices. Similar relationships between maintenance and operating data can reveal the efficacy of different maintenance practices.

The data collected by an industrial analytics solution can serve multiple purposes. First, the raw data and calculated values can be analyzed in near-real time to detect deviations and generate alerts that can enable users to avert pending problems. Second, it can be stored in a data warehouse for subsequent analysis using all of the tools available in the base analytics package. Due to the Big Data, organizations will want to implement a dimensional model that supports rapid slicing/dicing and drill up/down/through the dimensions of importance to the operation. Defining this dimensional model is another challenge, as most analytics suppliers have limited their efforts in building dimensional models to external-facing business activities. While it can take much effort to fully exploit analytics capabilities to gain insight into internal operations, the large potential benefits would justify the effort.

Presentation and investigation capabilities form the top layer of every industrial analytics solution. Standard analytics solutions offer powerful ways to view and analyze information that should be adequate to support users who want to analyze data according to product and asset hierarchies. However, organizations should also consider the additional value of integrating analytics with 3D plant models, network models, and geospatial systems, which, increasingly are being implemented in industrial applications.

Industrial Analytics versus Other Solutions

As noted earlier, industrial enterprises already use a variety of software tools to monitor and manage their internal activities. Industrial analytics complement, rather than replace these other investments and enables organizations to take their performance to even higher levels.



Industrial Analytics Offer Additional Focused Benefits

Industrial software application suppliers constantly add features to enhance the value of their products. Many have recognized that users increasingly want to analyze their activities to identify recurring problems and opportunities for higher efficiency. As a result, we now find analytics embedded in solutions for a variety of operational activities, like maintenance, quality control, and safety. In many cases, these tools are limited to calculating local KPIs and "slice-and-dice" analysis of activity records. In other cases, like process historians and reliability and MRO solutions, embedded analytics includes statistical analysis capabilities that help users assess correlations, quantify regression and time-series coefficients, identify optimum operating points, and test the efficacy of proposed strategies. The strength of these analytics solutions is that they are built-for-purpose; providing the specific tools needed in a familiar manner to people involved in specific activities. The weakness of these solutions is that they are lim-

ited to local data and lack the ability to relate performance with other things happening in the facilities.

Increasingly, industrial organizations recognize the benefits of aggregating information across departmental boundaries. They understand that every department contributes to the performance of their facilities and that independent, siloed improvement initiatives will never lead to operational excellence. To encourage more coordination and collaboration, these organizations are adopting broader performance metrics, like OEE, TEEP and Balanced Scorecards, and many have implemented manufacturing/operational intelligence solutions to provide cross-departmental visibility.

Industrial enterprises already use a variety of software tools to monitor and manage their internal activities. Industrial analytics complement, rather than replace, these other investments and enables organizations to take their performance to even higher levels.

Manufacturing/operational intelligence solutions answer two fundamental questions: "what happened?" and "what is happening now?" This is not enough to attain or sustain a position of industry leadership. Today's competitive world demands continuous improvement and requires organizations to answer a much broader range of questions.

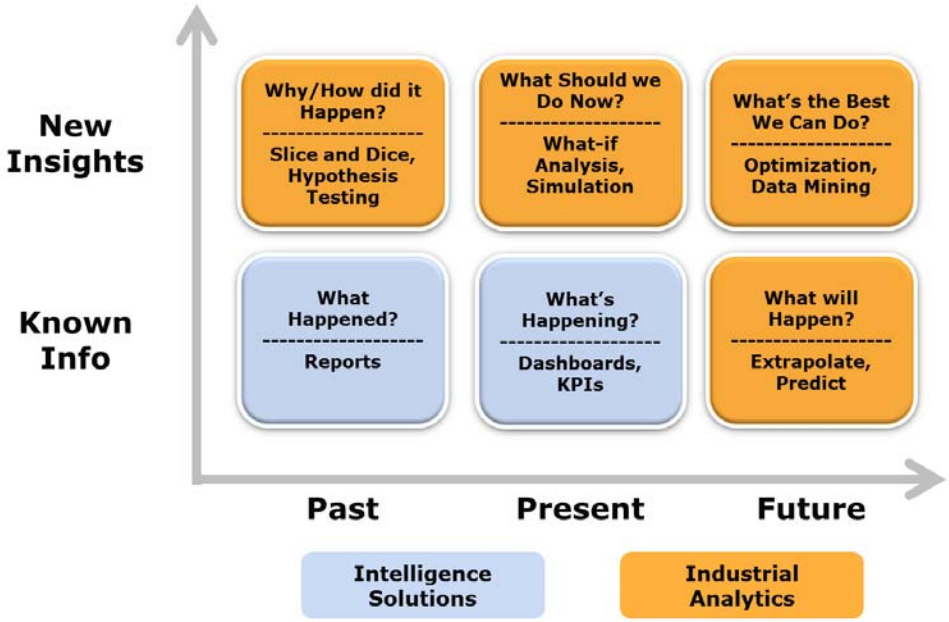
The foundation for these intelligence solutions is an integration layer with connectors for popular industrial applications and a calculation engine to evaluate KPIs, detect problems, and trigger alerts and/or automatic responses. On top of this, a presentation layer enables users to conveniently develop dashboards and scorecards and many suppliers offer pre-built screens for common operational roles. Most also offer the ability to drill down into the components of KPIs so that managers can quickly get to the root of performance problems.

The strength of intelligence solutions lies in their ability to present a unified view of performance and enable managers to respond rapidly to problems and negative trends. The primary weakness of most of these solutions is that they do not maintain any history or offer the advanced analytic tools needed to improve performance.

Industrial analytics provides organizations with the benefits of embedded and intelligence solutions while avoiding their weaknesses. Furthermore, they extend the underlying concepts to create additional opportunities for organizations to improve their operational performance.

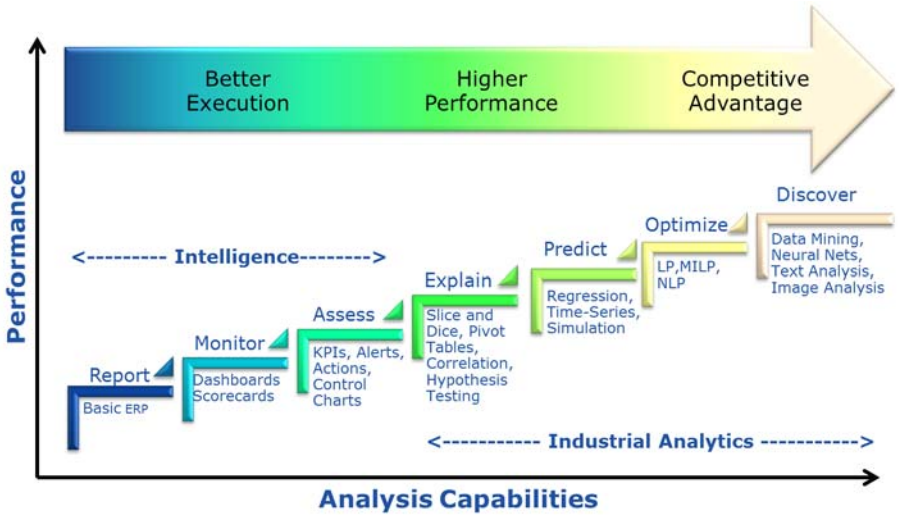
While powerful, manufacturing/operational intelligence solutions only answer two fundamental questions: "what happened?" and "what is happening now?" This enables organizations to assess their performance and maintain tight control, but it is not enough to attain or sustain a posi-

tion of industry leadership. Simply put, today's competitive world demands continuous improvement and this requires organizations to answer a much broader range of questions. They must understand the underlying drivers of their performance and have the information to address the root causes of every area in which they are deficient. They also need to know what the future will be like if they stay on the current course and what they can do to make the future brighter. Clearly, these are difficult questions that require extensive deliberations. Industrial analytics solutions may not provide the answers, but they can reveal valuable insights and enable an organization to test their beliefs and evaluate alternate ideas.



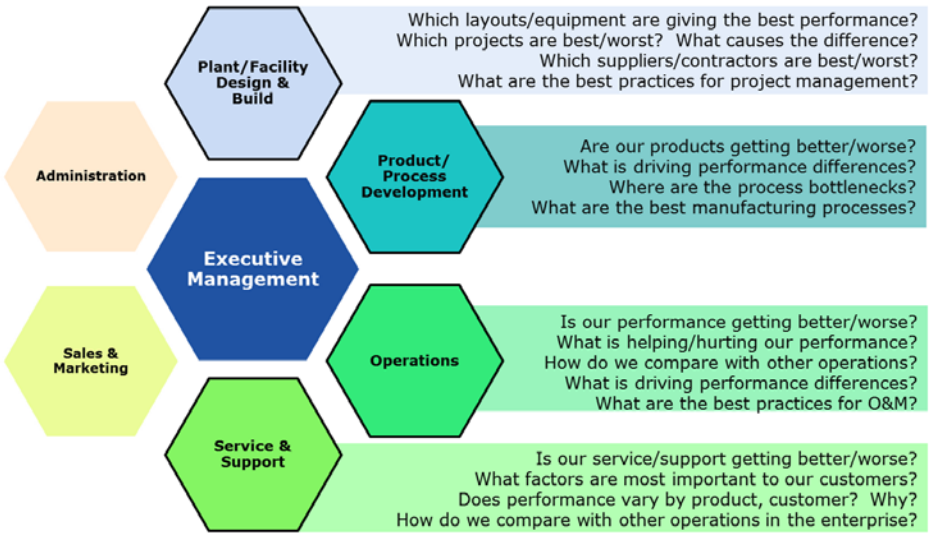
Industrial Analytics Provides Answers to More Questions

Industrial analytics solutions support these broader goals with a complete palette of data analysis tools. Some address basic intelligence needs while others can help organization optimize their practices and discover new opportunities for improvement. It is unlikely that any user will have the need or skill to apply all of these tools, but they should be made available to everyone to overcome any analysis hurdles in the path to better performance.



Industrial Analytics Includes a Full Palette of Analysis Tools

Furthermore, the underlying information integration platform and data warehouse enables all these tools to be applied across the organization. Individual departments can use them to address their own unique challenges with the benefit of access to information from all related departments. Management can also leverage this to improve performance on a cross-departmental basis.



Industrial Analytics Offers Additional, Focused Benefits

Implementing Industrial Analytics in Your Organization

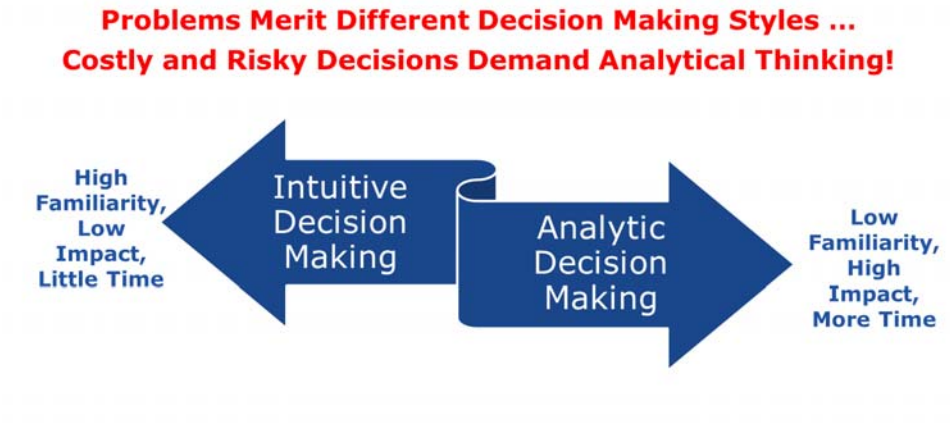
Industrial analytics capabilities overlap those of embedded and intelligence solutions. Organizations with little or no investments in embedded analytics or intelligence can therefore leverage industrial analytics as the basic infrastructure for all of their performance management and improvement initiatives. These solutions provide the tools needed to integrate and aggregate information, enable effective dashboards, and support everyone's analysis needs. Tailoring these general capabilities to individual needs will be the major hurdle.

Organizations with little or no investments in embedded analytics or intelligence would do well to consider industrial analytics as the basic infrastructure for all their performance management and improvement initiatives.

Organizations with existing investments in embedded analytics and/or intelligence face a different set of challenges. Users accustomed to existing tools will justifiably fight any replacement, even if it offers additional capabilities. Such organizations will be more successful if they develop a hierarchical strategy. Here, existing applications and tools would be used for local support, but the associated data would also be rolled up into a cross-departmental data warehouse that supports higher level needs and use of the more powerful tools available in an industrial analytics solution. Custom user interfaces can be developed as users find value in the expanded capabilities. This strategy may be maintained or the organization can migrate to a single solution to reduce IT maintenance and license costs as opportunities arise.

Organizations with existing investments in embedded analytics and/or intelligence face a different set of challenges. Users accustomed to existing tools will justifiably fight any replacement, even if it offers additional capabilities.

Regardless of the IT strategy, every industrial organization needs to recognize that the value derived from industrial analytics investments depends upon people actually using these tools to manage and improve performance. Traditionally, people lacked the data and tools to support analytical thinking. They have learned, and in many cases have been trained, to rely upon their experience and intuition to drive their decisions. A program that trains and encourages people to think more rationally and to base their decisions on facts, not guesses, is an essential part of every successful industrial analytics strategy.



Industrial Analytics Offers Additional, Focused Benefits

That said, organizations must also understand the limitations to analytical decision making. Analysis is simply not appropriate in certain situations, such as:

- There is no precedence and data is unavailable or hard to get
- When history might be misleading
- When the decision maker has considerable experience in the task at hand
- When variables cannot be defined or quantified adequately

Organizations must also take care to ensure that when industrial analytics are used, it is to drive decisions, not validate pre-conceived beliefs. Evidence shows that industrial analytics can provide a "lamp post" that illuminates the path for serious people who are trying to drive improvement. But there will also be people, who, like a drunk, only see this lamp post as something that can offer support, not change.

Analyst: Sid Snitkin
Editor: Paul Miller
Distribution: EAS Clients

Acronym Reference: For a complete list of industry acronyms, refer to our web page at www.arcweb.com/Research/IndustryTerms/

AIM	Asset Information Management
ALIM	Asset Lifecycle Information Management
ALM	Asset Lifecycle Management
APM	Asset Performance Management
BI	Business Intelligence
BOM	Bill of Materials
CAPEX	Capital Expenditures
D&B	Design & Build
EAM	Enterprise Asset Management
EH&S	Environmental Health & Safety
EIM	Enterprise Information Management
GIS	Geospatial Information Systems
HAZOP	Hazard & Operability
IT	Information Technology
MES	Manufacturing Execution System
MDM	Master Data Management
MI	Manufacturing Intelligence
MRO	Maintenance, Repair, and Operations
O&M	Operations & Maintenance
OI	Operational Intelligence
OPEX	Operations Expenditure
P&ID	Process & Instrumentation Diagram
QMS	Quality Management System
RCM	Reliability Centered Maintenance
SCM	Supply Chain Management
TEEP	Total Effective Equipment Performance
UI	User Interface

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