Digital Transformation: CHANGING THE FUTURE OF THE METALS INDUSTRY
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EXECUTIVE SUMMARY
Digitalization has an impact on every form of industry today, and the metals industry is no exception. The impetus to pursue Digital Transformation in metals industries needs to be an imperative as the risk of being left behind is greater than in other industries. It requires forethought, planning, focus on Operational Excellence and an understanding of how People, Process, and Technology combine for new business models and opportunities and create an environment where the next generation of workers will not just be capable, but actually enthused about coming to work.

The metals industry is in the midst of changes on multiple fronts.

- While the space has always been marked by specialized and more profitable niches, much of the metals industry has behaved as commodity product producers. Today’s markets demand more differentiation and higher service levels.

- An emphasis on sustainability by operating safely, cleanly and “greener” than ever before is impacting all businesses, but the metals industry faces greater scrutiny than many other industries.

- Material substitution driving down consumption and demand for many metals and recyclability is becoming a key driver for many metals users.

When you couple these challenges with the overall economic pressures and slowing global growth the metals industry must do something differently if it is to avoid becoming the next sunset industry.

Technologies like Mobility, Cloud, the Industrial Internet of Things (IIoT) and Big Data & Analytics are providing new tools the industry needs to transform itself into a more customer focused and responsive model. The growth of online commerce, mass customization and the development of new materials and production methods are creating tremendous opportunities to alter customer service in the industry.
Executive Summary (Cont.)

Envisioning, creating and managing Digital Transformation in any industry can prove challenging, but it is an effort the metals industry needs to undertake. Having a framework to guide the effort is essential. To be successful, metals companies need to

- Identify the business case for change with clear goals for transformation
- Create a culture that is adaptive and flexible
- Focus on continuous improvement leading to Operational Excellence
- Build partnerships with suppliers that result in an architecture that supports the business goals

This eBook will guide metals companies along the path to Digital Transformation. Specifically, you will gain a perspective on:

- What is driving the metals industry today?
- What is Digital Transformation in the metals industry
- How should a metals company set its strategic objectives as they relate to Digital Transformation
- How should a metals company define Operational Excellence in the context of their Strategic Objective
- How can a metals company create an Operational Architecture that will pave the way for Digital Transformation
- How are other metals companies building the business case for investment
SECTION 2

Research Demographics
Research Demographics

The data presented in this eBook is gathered from several ongoing surveys LNS Research conducts and was collected throughout 2015 to the middle of 2016. LNS Research deploys a social research model where our online format English language surveys are open to the general public. Companies participate in LNS Research surveys to gain access to the LNS Research library, meaning survey participants are research consumers as well. Each respondent is followed up with by multiple email and phone calls and each response is reviewed by an LNS Research analyst for accuracy. For this report the number of respondents to the questions ranges from several hundred to a couple of dozen depending on the specific question. The sample size is generally indicated on each chart.

In general, the metals industry responses align with the overall industry responses which represent several thousand respondents across a variety of industries split roughly equally between process and discrete manufacturers. Where the responses from the metals industry differ drastically from industry averages the difference is discussed.
SECTION 3

Metals Beyond 2020: Surviving the Challenges
An Industry Facing Many Changes

For an industry that has been around since the bronze age, metals faces some of its greatest challenges right now. Environmental issues, raw material supply and digitalization of all aspects of life are combining with critical labor shortages in some regions, energy cost and greenhouse gas issues in others, and a shift to alternative materials to create challenges. While a few sectors anticipate some growth over the next five years, the majority of the industry expect no growth despite global population increases coupled with a growing economic consumer class. The industry must adapt or face a very bleak future. The following chart reflects the responses of about 20 metals industry (and 600 overall) respondents, validates what is reflected in generalized industry reports from industry sub-sector organizations and regional groups representing the industry globally.
Efficiency Gains Will Drive Financial Results

The metals industry is under strong economic pressure. Sixty metals industries respondents identified their top economic objectives. Thirty-nine percent say that growing revenue is the top financial objective. Growing operating margins, expanding their markets, cutting costs and improving the return on their assets rounded out the top five responses. Operationally, the top objective is to improve operating efficiency with 53% identifying it as their top objective, 50% more than industry as a whole. Within the metals sector for Digital Transformation to gain top management buy-in it must deliver operational performance improvements.

Financial Objectives

Operational Objectives
Asset Performance Management is Critical

The metals industry is asset-intensive so Asset Performance Management (APM) is critical. Among asset-intensive companies "better operational performance" is the top reason to invest in APM. What is different from manufacturing as a whole is the metals industry named managing operational risk as their second most popular top driver compared to increasing capacity which was the second top driver for manufacturing in general.

The impediments to achieving their objectives vis-à-vis APM were more focused on Return on Investment (ROI) and Metrics Visibility than industry in general meaning any Digital Transformation initiative must recognize the challenges and provide solutions that deliver appropriate ROI.

APM Challenges
SECTION 4

Meeting Today’s Demands, Preparing for Tomorrow’s Success
Framework for Digital Transformation

Industrial companies today, including some in the metals sector, are pursuing Digital Transformation initiatives. What many companies are missing is a systematic approach to manage this transformation across all levels and functions of the organization. The LNS Research Digital Transformation Framework is designed to help industrial companies understand how to connect all of these simultaneous and interconnected initiatives.

**STRATEGIC OBJECTIVES:** At the highest level metals companies today need to be thinking about how many of these new technologies, like the IIoT, can disrupt and transform products, value chain business processes, and connected service delivery. An example would be to enable customers real-time access to shipment data from all service centers that are engaged in fulfilling an order including the metallurgical data on each product as appropriate.

**OPERATIONAL EXCELLENCE:** People, processes, and technology are the underpinnings of Operational Excellence initiatives and these initiatives are typically owned by the senior-most business function leaders in the organization. Moving forward, manufacturing companies...
Framework for Digital Transformation (Cont.)

must continue to evolve Operational Excellence initiatives as the continuous improvement engine of the company and the driving force for innovation.

**OPERATIONAL ARCHITECTURE:** Traditionally, Enterprise Architecture has been owned by the Information Technology (IT) organization. Separately, automation, corporate engineering, and/or advanced manufacturing (often now referred to as operational technology or "OT") has been responsible for the rest of the technology architecture at the manufacturing facilities. With the emergence of IIoT, LNS Research recommends industrial companies adopt an Operational Architecture approach that applies the formalized rigor and process of Enterprise Architecture to the entire IT-OT stack. Industrial companies need to create supporting and collaborative groups that incorporate both IT and OT, and as the Chief Digital Officer emerges, the success of this new collaboration is a key part of their charter.

**BUSINESS CASE DEVELOPMENT:** Business case development initiatives are most successful when they are driven by deep subject matter experts that understand both the process and technology. Identifying these experts can be a challenge but often they are located in advanced manufacturing, hybrid IT/OT roles, are a leader within specific business functions, or are a technical fellow supporting the organization. It is important industrial companies do not view technology investments as a one-off business case but rather as a business case journey that aligns with system architecture goals and supports long-term Strategic Objectives.

**SOLUTION SELECTION:** Often companies view Digital Transformation upside down, starting with solution selection, which then drives all other portions of the framework and as with solution selection, it is important to put the activities in context of broader initiatives. Solution selection is never successful in a vacuum and when done in such a fashion, change management becomes an insurmountable challenge and adoption wanes.
A New Model for Operational Architecture

In moving to a new model of Operational Architecture, companies need to move to an expanded scope of Enterprise Architecture. This expanded scope should account for managing "things" across the value chain of suppliers, internal operations, customers, and products as well as an application and analytics environment that spans cloud/on-premise and time-series/structured/unstructured data types. Upon careful inspection, this expanded model should also incorporate the main components of the IIoT Platform: Connectivity, Cloud, Big Data Analytics, and Application Development. This expanded scope is also too broad for making meaningful architectural decisions across the enterprise. LNS Research recommends a three-level approach, where at Level 1 the entire scope is encompassed.

LEVEL 1 Operational Architecture

At the next level of detail, a particular element of the high-level architecture should be examined. For example, an organization’s Level 2 Operational Architecture for structured data analytics and apps would largely map to the traditional scope of enterprise applications.

When building this architecture, LNS Research recommends not focusing on the traditional applications of Enterprise Resource Planning (ERP), Product Lifecycle Management (PLM), Manufacturing Execution System (MES), Supply Chain Management (SCM), and Client Relationship Management (CRM), but instead focus on the functional areas and map these to the corporate systems/management systems/value chain systems used across execution/planning/analytics. Then the different applications can be mapped to this model, not vice versa.

LEVEL 2 Operational Architecture
A New Model for Operational Architecture (Cont.)

At the most detailed view, or Level 3 Operational Architecture, individual and specific elements of Level 2 will be integrated. Examples of this could include the specific pieces of functionality that are included within Manufacturing Operations Management or the specific security, device management, and communication protocols that are used for smart connected devices.
The Difference Between a Lot of Data and Big Data in the Metals Industry

LNS Research recommends taking a relatively generic IT view of what Big Data is and then applying the definition to the industrial space. One definition that has received broad acceptance is the 3 V’s of Big Data:

- **Volume**
- **Velocity**
- **Variety**

The industrial space has typically had to deal with large volumes and velocity of data. Also, some heavily instrumented ore excavating machinery and haul trucks can produce several gigabytes of data per hour regarding equipment performance. All of this data though, has been relatively well-structured process data stored as time series data or transactional data stored as structured data in enterprise applications and historians.

With the advent of the IIoT, companies will also need to deal with unstructured data in the form of new machine-generated, sensor, video, geographic information system (GIS), Web, and other forms of data. As all of these data types come together, companies will truly have to deal with Big Data, which will bring together a whole new set of analytics opportunities and challenges.

Traditionally analytics has been viewed as a linear progression of:

- **Descriptive**: Metrics and Scorecards for Overall Equipment Effectiveness (OEE), on-time delivery (OTD), scrap, mean time to failure (MTTF)
- **Diagnostic**: Reliability engineering, quality engineering, root-cause analysis
- **Predictive and Prescriptive**: modeling and simulation, statistical process control, advanced process control

While the first two types of analysis can be accomplished with traditional analytics tools, the third—prescriptive analytics—requires Machine Learning capabilities to achieve maximum value.
Digital Transformation Requires More Than Old Analytical Approaches

Big Data has created a powerful new approach to analytics in areas outside of manufacturing already, and now it is manufacturing's turn to benefit from these advances by applying them to production processes. The most important aspect of this approach is the concept of machine learning applied to Big Data which allows companies to address issues that they were not only unable to previously, but may not even have known they had. So while the IIoT is a critical source of the data, it is the Analytics that will create the value from this information, in multiple ways.
Innovative Business Models for Metals

Unlike industries where the products themselves are becoming smart and connected such as the automotive and aerospace industries or even the consumer electronics sector, metals industries will see Digital Transformation take place in both the production processes and in the products themselves with the production processes being impacted sooner.

One key trend the industry can expect to see is the shift away from capital and into capacity. The cost of a new mill and processing unit can easily approach $1 Billion. As machinery suppliers and constructors start to leverage Digital Transformation themselves, they will begin to offer metals companies the ability to buy production capacity instead of investing massive amounts of capital in building new mills.

At a minimum, and as a transitory step, smarter assets will make it far easier for metals companies to demand machine reliability and uptime guarantees and performance guarantees from their suppliers. This improved reliability will lower their cost of production and allow them to produce products specific to customer demand.

Customer service will also improve. With far better data handling capabilities, metals companies can provide far more detailed quality information to their customers ultimately allowing those customers to schedule their rolling, cutting, forming or other processing operations far more effectively. In an industry that has traditionally been thought of as more closely aligned to commodity production the ability to create added value with information becomes a true differentiating factor.

As machinery suppliers and constructors start to leverage Digital Transformation themselves, they will begin to offer metals companies the ability to buy production capacity instead of investing massive amounts of capital in building new mills.
SECTION 5

Metals: Just Starting the Journey and Accelerating Efforts
The Metals Industry Needs to Invest

The Metals Industry is coming to grips with the technologies that are driving Digital Transformation and is optimistically driving forward. If it can accelerate its understanding of Digital Transformation and Smart Manufacturing it can become an example of IIoT drives Digital Transformation.

INVESTMENT PLANS IN METALS LAGGING INDUSTRY AS A WHOLE

The metals industry recognizes that IIoT can yield significant benefits and is planning for future investment. However, actual deployment rates lag behind other industries.

IoT Investment Plans

Have you started an IIoT initiative?

- We do not expect to invest in IoT technologies in the foreseeable future
- We expect to invest in IoT technologies in the next 12 months but are still establishing the budget
- We do not expect to invest in IoT technologies in the next 12 months
- We have made significant investment already and expect it to increase in the future
- We have established a budget for IoT technology investment in the next 12 months
- We have made significant investment already and expect it to stay the same for the foreseeable future
- We have made significant investment already and expect it to decrease in the future
Other Industries Illustrate Additional IIoT Opportunities

METALS COMPANIES PURSUING DIFFERENT IIOT USE CASES TODAY AND GOING FORWARD.

Within the metals sector today the top three use cases are production visibility, quality improvement, and energy efficiency. Going forward production visibility and quality remain the top use cases, but asset reliability will gather more attention and investment.

IIoT Use Cases: Today and Future Plans

![IIoT Use Cases Chart]
Better Business Cases Will Drive IIoT

METALS INDUSTRY STRUGGLES WITH FUNDING AND BUILDING THE BUSINESS CASE & HAS SECURITY CONCERNS

The metals industry is struggling to build a strong business case for IIoT investment and to find funding for IIoT investment. Metals companies should look to other industries to see how they have overcome these challenges. Rethinking the value of IIoT regarding the use cases identified above can help the industry make the business case, but it will require stronger customer engagement to assist in that effort. Any Digital Transformation effort must overcome security concerns as well. Machine learning is another technology investment that will improve the business case for IIoT by driving additional value from the wealth of information.

Obstacles to IIoT Investment
Technology is a Lever to Address Challenges

Technology is the underpinning of business applications; ultimately applications need to provide business value. Like manufacturing in general, application investment areas in the metals industries closely align with industry overall. Big Data investments are lagging somewhat, but the industry does have a focus on implementing MOM applications going forward, something many other industries have already done. This is another area where Machine Learning has the potential for high payback.
Automation is An Enabler

Differences in how metals companies operate explain many differences in its approach to Digital Transformation. The metals industry is one of the more automated industries there is today. This should make it easier to begin the Digital Transformation process for metals companies. So while there are economic challenges, those companies that devise a mechanism to find and define the Business Case for Digital Transformation will be well positioned to make the move quickly and benefit the most.

Approach to Operations
SECTION 6

Defining Success
**Metals Driven by Economics**

To better understand the value of actually pursuing Digital Transformation one need only look at how companies that have started deploying technologies like IIoT and Analytics perform compared to those that have not made investments in these enabling technologies. Some of the earliest success stories relating to Digital Transformation and the deployment of IIoT to improve business performance have originated in the metals industry. At times metals seems to view itself as a laggard, but in reality, it is proving to be a fertile proving ground. More companies just need to follow its pioneering examples to elevate the industry as a whole.

**METALS IS A METRIC INTENSIVE INDUSTRY**

Metals leads in some areas and closely follows industry as a whole when it comes to using metrics to guide the business. With such a strong focus on metrics building a business case for solutions that help measure and display performance in all of these areas should be relatively straight forward. Digital Transformation advocates in metals should focus on demonstrating how IIoT and other technologies will support the metrics activities.
Metals: Asset-Intensive and Focuses on APM Performance

Metals manufacturing is one of the most asset intensive industries there is with some companies spending a significant portion of their operating expense budget on maintenance. Metals companies are highly metric driven so to build a business case for technology investment, and the collection and display of the APM metrics is just as valid as with the operational metrics mentioned previously. But more importantly, case studies in the industry have shown the ROI of IIoT and predictive analytics investment in metals exceed those in many other industries.

**APM Metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>All Manufacturing</th>
<th>Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Time Between Failures (MTBF)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Time to Failure (MTTF)</td>
<td></td>
<td></td>
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<tr>
<td>Mean Time to Repair (MTTR)</td>
<td></td>
<td></td>
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<tr>
<td>Unplanned downtime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability/Availability (Uptime %)</td>
<td></td>
<td></td>
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<tr>
<td>Planned vs Unplanned work %</td>
<td></td>
<td></td>
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<tr>
<td>Work order backlog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work order closure rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance cost per unit of production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor/planner</td>
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</tbody>
</table>

**Graph:**

- The graph compares the APM metrics between all manufacturing and metals industries.
- Key metrics include MTBF, MTTF, MTTR, unplanned downtime, reliability/availability, planned vs. unplanned work, and maintenance cost per unit of production.
- Specific values for each metric are not provided in the image.
APM Can Be The Difference Between Profitable and Operating in the Red

Best in class performers in the metals sector report benefit levels that can mean the difference between being profitable or not. Numerous studies by organizations such as SMRP, Reliabilityweb.com and others all point to savings opportunities.

**Advanced APM Benefits**

- Reliability/Uptime Increase
- Reduction in Turnaround Times
- Reduction in Number of Unexpected Failures
- MTBF Increase
- MRO Spares Inventory Reduction
- Maintenance Budget Reduction
Digital Transformation Will Require A Change From the Status Quo in Metals
Metals Has a Head Start with Automation

The metals industry has the advantage when it comes to Digital Transformation in that it has more automation and digital technology in place already than many other forms of industry but because investment in technology refresh is lagging other industries it often may not be IIoT enabled.

Current Automation
Metals Must Adopt IIoT Architectural Models

The metals industry needs to change its thinking when it comes to IIoT Architecture. The industry has a few progressive thinkers when it comes to Digital Transformation but the industry overall lags compared to almost every other form of manufacturing when it comes to building out an infrastructure that will readily enable IIoT data flow as shown below. CIO’s in the industry should start focusing on this if they want to add value going forward.

In general, the metals industry has granted broader external access to plant operational information than manufacturing in general. This willingness to provide broader insight should allow faster time-to-value from making more data usable via Big Data & Predictive Analytics, but it does carry some security risks as discussed in the next few pages. One area that the industry could improve on is allowing suppliers greater access to information.
External Access

While the actual device type varies somewhat from industry in general, the metals sector closely aligns with overall adoption of mobile technology with Apple devices dominating the mix. Since mobility is a critical element of Digital Transformation the sector is well positioned to reap benefits.

The shift to wearables as another avenue for mobility is consistent with industry in general, so metals companies only need to follow the market in this area from a technology perspective.

One of the greatest opportunities is to use Machine Learning to provide operators with guidance on how to achieve Operational Excellence. As operators have more to do and cover more physical territory, mobility will be a key enabler. Together Machine Learning and mobility can empower a new generation of workers.
Mobility Already Accepted

### Mobile Devices

- **iPad**: 25% All Manufacturing, 30% Metals
- **None**: 10% All Manufacturing, 15% Metals
- **iPhone**: 40% All Manufacturing, 45% Metals
- **Android phone**: 20% All Manufacturing, 25% Metals
- **Ruggedized Windows tablet**: 15% All Manufacturing, 20% Metals
- **Other industrial tablet**: 5% All Manufacturing, 10% Metals
- **Windows tablet**: 0% All Manufacturing, 5% Metals
- **Ruggedized Android tablet**: 0% All Manufacturing, 5% Metals
- **Other phone**: 5% All Manufacturing, 10% Metals

### Smart Wearables

- **None**: 70% All Manufacturing, 75% Metals
- **Location devices**: 20% All Manufacturing, 25% Metals
- **Glasses**: 10% All Manufacturing, 15% Metals
- **Wearable bar code scanners**: 5% All Manufacturing, 10% Metals
- **Other**: 0% All Manufacturing, 5% Metals
- **Smart watches**: 0% All Manufacturing, 0% Metals
Industry is Security Conscious

The metals industry, if it is to take advantage of the networked digital future must improve its security practices. Metals falls far short of industry in general when it comes to security. As the industry moves into the digital era, it needs to pay far greater attention to cyber security. It will be an imperative to partner with providers that are security conscious and consider a shift to platforms that are inherently secure.

Have you had any plant IT security breaches and if so from what source?

- None: 50%
- External device (USB stick, etc.): 40%
- Malware from another part of enterprise: 30%
- Denial of service attack: 20%
- Direct attack on control systems: 10%
- Other: 0%
SECTION 8

Recommendations
Recommendations for the Metals Industry

With all of the pressures facing the metals sector, from labor issues to regulatory issues, to wildly fluctuating economic conditions, metals companies need to start the pursuit of Digital Transformation. Five key steps they should take to secure their future in the digital world are:

**Start now by defining how they want their business to look 5 to 10 years down the road.** Digital Transformation is a journey that requires a vision. Setting strategic objectives that will transform the business is the first step.

**Define success – know what Operational Excellence looks like.** This means understanding what factors will drive customer satisfaction, enable maintenance of the ability to produce products in a sustainable fashion, and create the profits that shareholders will demand. It also means defining the metrics that measure success in these areas and ensuring that appropriate measurements are made and information shared.

**Create an Operational Architecture that defines the technology people will use to support the business processes that create value.** Metals companies need to make sure that existing technology is integrated into their architecture if it is capable, and if not make appropriate investments in the right technology. It is all about getting the right information to the right people at the right time – that hasn’t changed in over 30 years.

**Select partners that share the Digital Transformation vision and can provide a platform upon which to build.** While no single vendor can provide every element of technology needed to Digitally Transform a business, many suppliers understand the challenges and are moving away from selling products and instead delivering platforms upon which all parties including the metals companies can build the right solutions that enable those companies to meet their strategic objectives. When selecting a partner consider the following:

- How open is the platform? How many vendors support it?
- How extensible is the platform? Does it extend across OT and IT?
- How are industry specific requirements supported? Do specialized applications work with the platform?
- What is the history of innovation? Does the vendor have a track record of commitment to technological currency?

**Start investing today in both infrastructure and technology.** Metals companies have an advantage in that they are generally highly automated and mobility solutions are fairly common. However, the underlying infrastructure, applications and IT need refreshing in most companies to pursue Digital Transformation.

Technology is changing industry and time is running out. Digital Transformation is accelerating across all industries and metals is no exception. Early adopters in metals are showing that there are real, measurable benefits from leveraging technology. Those companies that have yet to pursue things like the IIoT, Cloud-based solution and Big Data with its associated Analytics risk falling so far behind the competition that they become the victims as consolidation and business model changes reshape the entire sector.