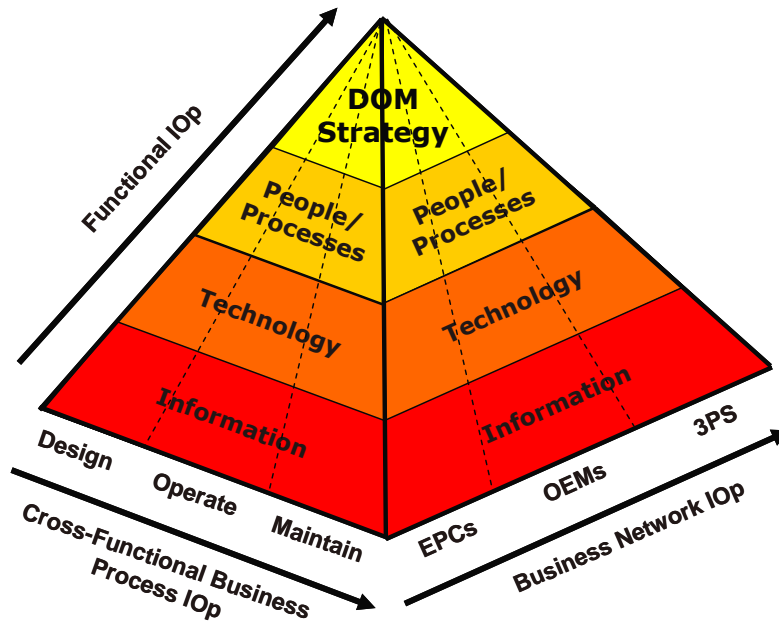


Use DOM Interoperability to “Flatten” Your Design, Operate & Maintain Activities

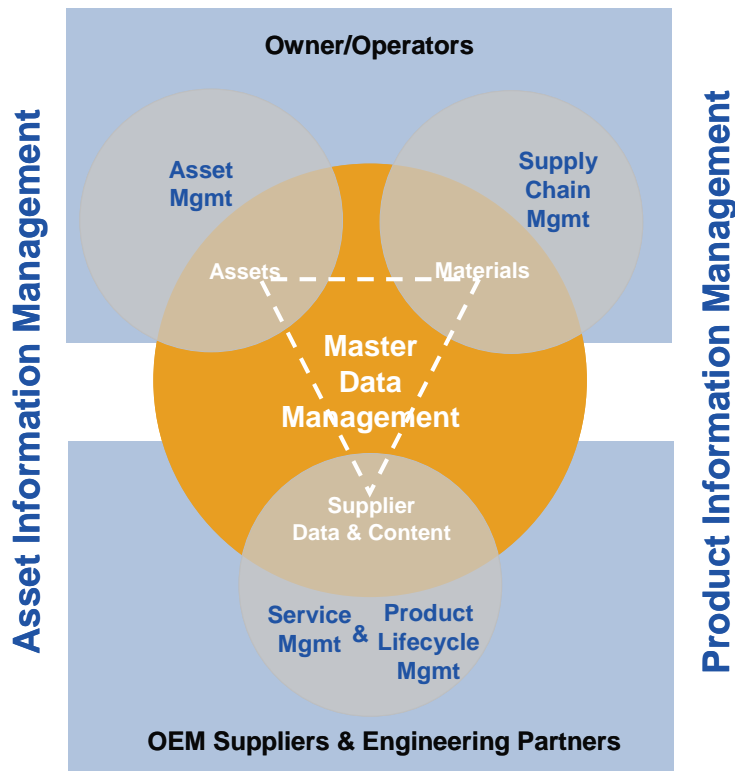
The Benefits are Large and Compelling

Executive Overview	3
What is DOM Interoperability?	4
Achieving DOM Interoperability	5
The Value of DOM Interoperability	6
NRX Asset Hub Meets the Challenge	11
Waiting is Not an Option	17





DOM Requires Interoperability in 3 Dimensions



NRX Asset Data Model links Assets, Materials and Supplier Data & Content

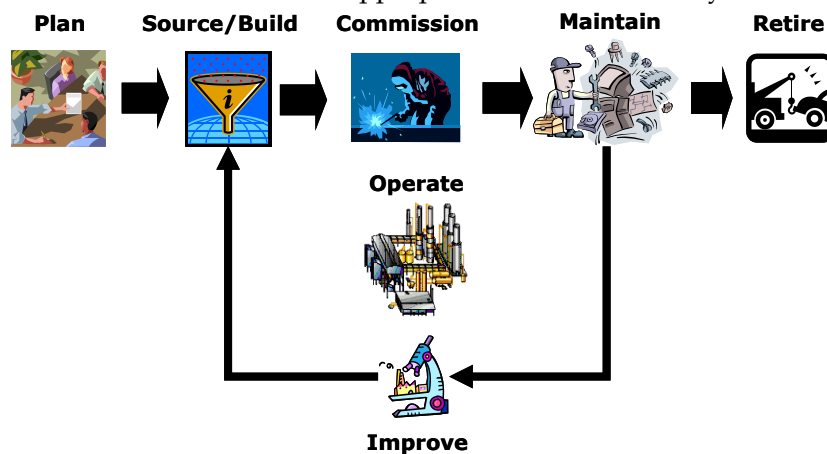
Executive Overview

“Better Plant Performance” is high on the agenda of many CEOs today. Some industries, like Oil & Gas, are faced with capacity limitations and need to get higher output from every plant. Other industries face overcapacity and are trying to rationalize their assets to reduce operating costs. In all cases, investments in plant upgrades and new facilities are coming under intense scrutiny.

Overcoming the hurdles that exist in information sharing and collaborative problem solving provides immediate benefits in Productivity and positions the organization for the long term benefits of more effective, collaborative asset management practices.

Plant Performance, whether we use output or cost as the measure, is determined by three factors: the plant’s inherent capability to produce the desired products; the effectiveness of operations in using these capabilities; and, the availability of the plant for operations. These three factors, which we refer to as Design, Operate and Maintain (DOM), are highly interdependent and are generally the responsibility of different groups within the organization.

Many companies are looking to technology to help them address capacity, cost and availability challenges. But technology alone is not the answer. Capacity/availability limitations and cost inefficiencies are as much due to gaps in information and business process interoperability as they are to lack of appropriate sensors and analysis tools. Overcoming the hurdles that exist



ARC CALM Asset Lifecycle Model

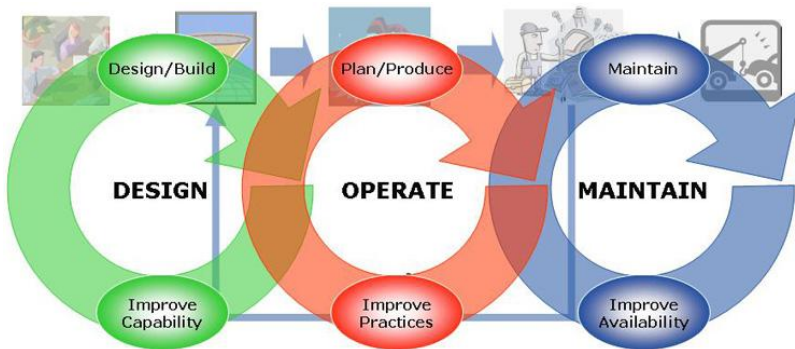
ist in information sharing and collaborative problem solving among DOM groups would provide immediate benefits in Plant Performance as well as empower the enterprise to develop new, more effective asset management practices.

Studies, such as the NIST Report¹, have shown the incredible costs that can be saved through interoperability across the DOM activities. But the ability to create new, horizontal, collaborative strategies is the “hidden jewel” that

¹ **Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry**, National Institute of Standards and Technology, NIST GCR-04-867, August 2004.

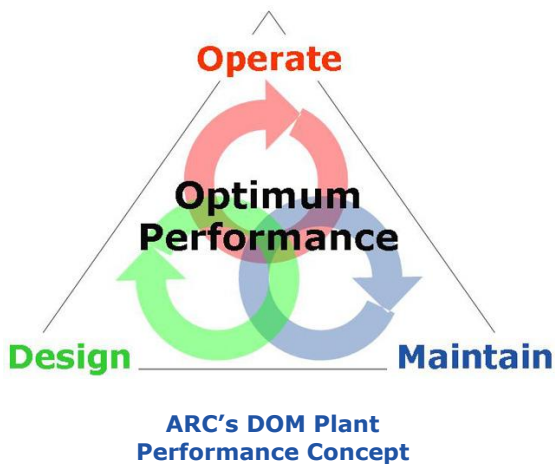
will help organizations counter emerging threats from global competitors and compete in the “Flat World²”. Combined, these benefits make a compelling case for immediately implementing DOM Interoperability across your capital projects supply chain.

What is DOM Interoperability?



Design, Operate, and Maintain are Continuous Processes

Traditional Plant Lifecycle models present the many stages and activities in a plant’s lifetime as a set of independent, sequential “baton passing” stages. Under this view, asset optimization focuses on improving the efficiency of each stage. More modern views of Plant Lifecycles recognize that Design, Operate and Maintain are actually continuous loops that interact throughout the Plant’s lifetime as obsolete equipment is replaced and upgraded. Design and Maintenance play the key role of supporting more effective operation. Plant Performance reflects the aggregated, interdependent effect of all of these efforts.



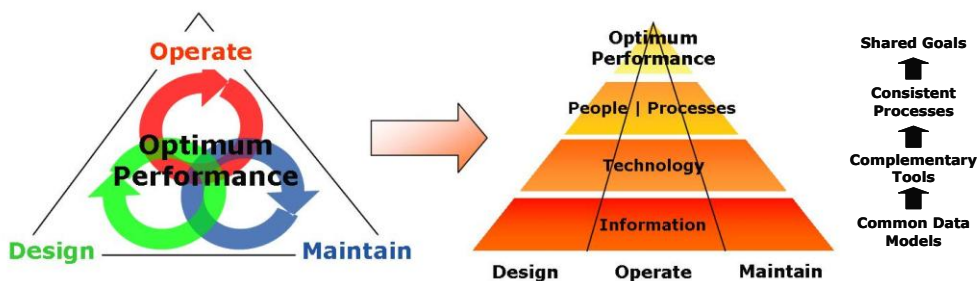
Like many things, interdependence can be a blessing and a curse. When interdependence is understood and exploited, effects of a change can be amplified. However, when interdependence is not recognized and managed, efforts to improve performance through one factor can be confounded by the negative effects produced upon other DOM factors, wasting time and money. Understanding and dealing with interdependence must therefore be addressed in all Plant Performance improvement strategies.

² References to the Flat World and flattening in this report are attributed to **The World is Flat, A Brief History of the Twenty-First Century**, Thomas L. Friedman, (2005), Farrar, Strauss and Giroux (publishers), pp 176-200.

While DOM coordination is necessary, organizations cannot allow this to cause excessive delays in making decisions and implementing changes. Today's "Flat World" business environment demands that companies continuously operate at peak performance and have the ability to rapidly adjust their strategies. The objective must therefore be seamless and efficient coordination among DOM groups. DOM Interoperability addresses this need by enabling various organizations and applications to function as if they were a single entity, with a common set of goals and action plans. To achieve DOM Interoperability an organization needs an infrastructure that supports information sharing and collaboration across all levels of activity.

Achieving DOM Interoperability

People, Processes, Technology and Information provide the infrastructure for organizational effectiveness. Together, they determine a company's ability to achieve and maintain Optimum Plant Performance. While opinions may vary regarding the importance of each component, we believe



ARC Model for DOM Interoperability

they form a pyramid when it comes to DOM. An ideal infrastructure supports interoperability across each layer of this pyramid.

People and Business Processes are the prime movers for all organizational activity. The ability for these entities to act collaboratively across DOM boundaries has a direct impact upon how well and how fast changes are implemented. Technology in the form of software tools allows people to do things faster and organizations to create automatic workflows. Sensor and measurement technologies provide additional support in terms of better information that enables faster problem diagnosis and on target solution development/deployment. Information underlies and enables the use of technologies and forms the foundational layer of the effectiveness pyramid.

People and Business Processes are the prime movers for all

DOM Interoperability includes interoperability at all levels of the performance pyramid and is more than information system integration. DOM Interoperability includes: **Common Data Models** that enable direct information sharing across groups; **Complementary Tools** that allow groups to directly share their analysis of problems and proposed solutions; and, **Consistent Processes** that allow people to interact effectively, ensuring a common understanding of goals and synchronization of individual actions.

The Value of DOM Interoperability

DOM Interoperability creates value in multiple ways for asset owners/operators. Most apparent is the direct impact it can have on the productivity of the key groups involved in DOM activities. The table below highlights some of these benefits.

To -> From	Design	Build	Operate	Maintain	Improve
Design	Reduced design time, Fewer errors, Better designs	Reduced build time, Lower material costs, Fewer CNs, Better planning	Better use of capabilities, Safer operation, Faster trouble-shooting	Better spares mgmt., Better PM strategies, Faster repair of failures	Better equipment strategies, Longer asset lifetimes
Build	Better upgrades, Improved designs, Faster problem resolution	Better mgmt. of all build resources, Better build planning	Better oper. planning during upgrades, Reduced trouble-shooting time	Better shutdown planning, Faster repair of failures	Better reliability analysis, Faster identification of asset problems
Operate	Better oper. support, Better upgrade planning, Better designs	Better upgrade planning, Faster problem resolution	Better planning, coordination and mgmt. of all operating activities	Better maintenance planning, Faster repair of failures	Better analysis of equip. performance and improvement strategies
Maintain	Better maint. support, Better upgrade planning, Better designs	Better shutdown planning, Faster problem resolution	Better planning, of operating activities, Reduced trouble-shooting time	Better mgmt. of all maintenance resources	Better analysis of equip. reliability and improvement strategies
Improve	Better upgrade planning, Better designs	Better upgrade planning	Better use of operating resources, Longer asset lifetimes	Better PM strategies, Better CBM mgmt.	Faster ID of latent equip. problems, Benchmarking with other groups, plants

While not specifically identified in the NIST report³, these benefits reflect the losses incurred by the various groups included in that study. NIST es-

³ **Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry**, National Institute of Standards and Technology, NIST GCR-04-867, August 2004.

estimated this loss to be \$15.8B per year for a specific portion of the North American Capital Projects industry, totaling \$374B of capital spend. This loss equates to 4.2% of the installed asset cost and the researchers believed that this was likely a low estimate of the full impact. A large portion of this (\$10.6B per year) was identified as losses incurred by asset owners/operators during operate and maintain stages, including a significant portion (approx 30%) related to information validation. When viewed from this perspective, the value of DOM Interoperability is clearly staggering and demands immediate attention by all parties.

While impressive, the losses identified in the NIST report still only represent a fraction of the opportunity that companies have to improve their performance by implementing DOM Interoperability. Not only will DOM Interoperability improve the efficiency of current information exchange processes, which are the focus of the NIST report, it also enables companies to develop new, more innovative processes that can drive step changes in performance across all of the DOM functions. Being new, the value of these processes can be difficult to estimate, but experience in other fields shows that the impact of this kind of cross-functional Interoperability can be game-changing.

Lessons from “The World is Flat”

“The World is Flat”, the best-selling book by Thomas L. Friedman, provides us with some important insight into the future business environment that all companies will be facing (see sidebar on next page). Friedman’s observations also highlight how some organizations are already exploiting this situation to implement horizontal, collaborative business processes to drive quantum changes in their performance. For example, HP used Flat World capabilities to shift from “eighty-seven different supply chains - each managed vertically and independently, with its own hierarchy of managers and back-office support - to just five supply chains that manage \$50 billion in business, and where functions like accounting, billing and human resources are handled through a companywide system.” Instead of focusing on ways to improve the productivity of people operating in traditional, vertical business silos, HP demonstrated how collaboration could be used to eliminate waste and shift work to the most efficient, global resources.

“The World is Flat”, the best-selling book by Thomas L. Friedman, describes three convergences that have created a truly global playing field where individuals and companies are forced to become more creative and continuously focused on performance excellence.

Convergence 1 – The Ten Flatteners

The first convergence “flattened the world” by bringing together a set of technology developments, social changes and business practices that created “a Global, web-enabled playing field that allows for multiple forms of collaboration – the sharing of knowledge and work – in real time, without regard to geographic distance, or, in the near future, even language.”

Convergence 2 – New, Innovative Processes

The second convergence melded this new “flattened world” with skilled, innovative people who were comfortable enough with its capabilities to develop “the sorts of horizontal collaboration and value-creation processes and habits that could take advantage of this new, flatter playing field. In short, the convergence of the ten flatteners begat the convergence of a set of business practices and skills that would get the most out of the flat world. And then the two began to mutually reinforce each other.”

Convergence 3 – Many New Players

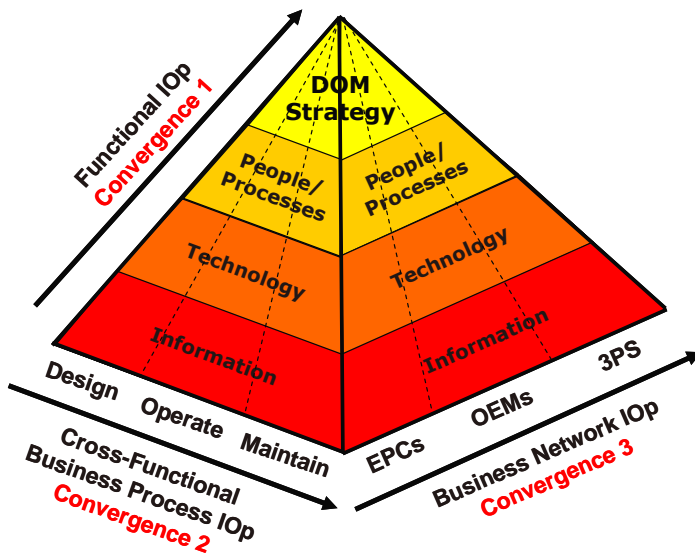
The third convergence represents the collision of the flattened world with enormous populations of people entering the global marketplace from the previously excluded societies of China, India, Russia, Eastern Europe, Latin America and Central Asia. And these people entered the market “Right when the field was being flattened, right when millions of them could compete and collaborate more equally, more horizontally, and with cheaper and more readily available tools than ever before. Indeed, thanks to the flattening of the world, many of these new entrants didn’t even have to leave home to participate. Thanks to the ten flatteners, the playing field came to them!”

Collaboration is one of the game-changing capabilities in Tom Friedman’s Flat World. It is the chief enabler of the horizontal, collaborative business strategies that drive significant performance gains. The Internet and standard web browsers provide the basic platform for this collaboration. But these capabilities are not sufficient to support the kinds of collaborative business processes that asset owners need to drive quantum improvements in their DOM processes.

Collaboration in the DOM world involves information access and work sharing across people, processes and their supporting technology. Interoperability (IOp), which is the ability of products, systems, or business processes to work together to accomplish a common task, is required to enable DOM collaboration. And, given the complexity of DOM processes, multiple forms of Interoperability are required. Conveniently, the three convergences that created the Flat World provide a good model for discussing these different forms of Interoperability.

Functional IOp

The first convergence provides broad access to information and a basis for individuals to collaborate on an ad hoc basis. These capabilities enable individuals within functional groups, like Design, to optimize their own performance and to share their efforts with peers who are working on the same projects and issues. This form of Interoperability, Functional IOp, bridges the vertical layers of the performance pyramid, often through use of integrated functional suites of solutions, to increase synergy among the fac-



Interoperability Flattens the DOM World

strategy. An additional goal for many organizations is to achieve a state where the business process flows automatically and consistently, with minimal human intervention.

In the DOM context, an organization that implements Cross-Functional Business Process IOp is addressing the root cause of many of the losses identified in the NIST report – poor information handover. It would establish the rules by which documents are exchanged and make handover a well-defined, consistent process that improves both information accuracy and completeness. Use of complementary toolsets, furthermore, ensures that this information can also be conveniently used within each of the DOM groups.

Organizations that implement Cross-Functional Business Process IOp will also be enabling their people to develop new, innovative ways to accomplish DOM tasks more efficiently and effectively. For example, they might replace information handover, with sharing of a single information source, and in the process provide downstream groups with earlier access to vital information. Operations and Maintenance groups have different information needs than Designers, such as parts lists and operating, safety and maintenance procedures, but design information remains the basis for all of these items. Early access to design information can smooth and shorten startups of new facilities and process upgrades.

tors and to enable seamless exchange of people, technology and information.

Cross-Functional Business Process IOp

Cross-Functional Business Process IOp enables effective, horizontal collaboration across the many functional groups that contribute to the complete DOM business process. This corresponds to the kinds of processes that Friedman describes in convergence 2 of “The World is Flat” and which provide the basis for quantum gains in performance. The focus of this form of Interoperability is to optimize performance of the horizontal, collaborative

An approach that shares a single-version-of-the-truth would also enable more coordinated action across all DOM groups. For example, engineering groups considering possible upgrades to improve throughput would no longer have to base their analysis on out-of-date design information. Changes to the process equipment, operating procedures and equipment reliability would be readily apparent and they would avoid the purchase of wrong or unnecessary equipment, saving capital and time. Maintenance groups could likewise avoid buying costly parts for equipment that has been marked for replacement.

Business Network IOp

The final form of Interoperability, Business Network IOp, helps to make the organization more flexible and agile in its efforts to reduce costs and improve performance through outsourcing. A key focus of Business Network IOp is to ensure that such activities neither disrupt the smooth, efficient flow of information occurring through Cross-Functional Business Process IOp nor jeopardize the organization's security and privacy by allowing less authorized parties to access confidential information. Business Network IOp does this by implementing Interoperability on the basis of a more formal, arms-length partner management strategy.

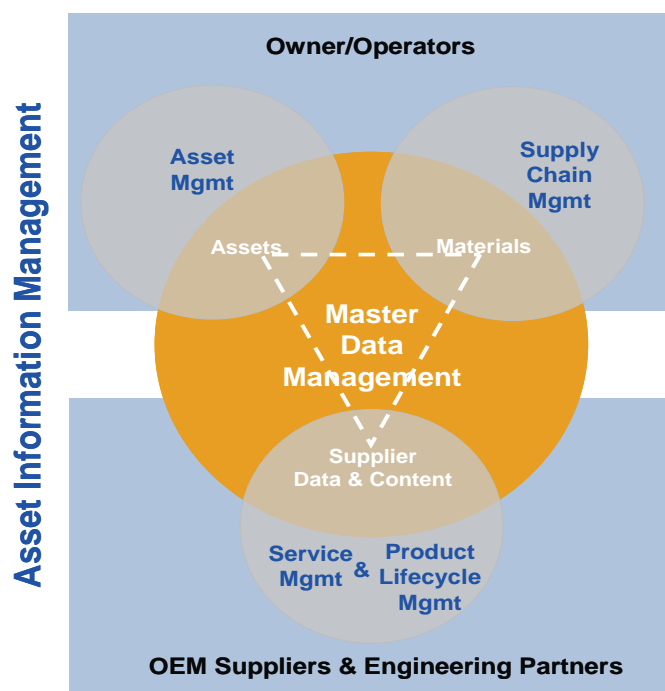
Any organization that wants to reap the full benefits of DOM Interoperability will need to implement a solution that addresses all of these forms. Ideally this would include a software infrastructure based upon a Service Oriented Architecture (SOA) that would facilitate convenient connectivity among the various application suites selected by different DOM groups, whether they are internal or external to the enterprise. The value of SOA has been recognized by major solution providers in the DOM arena, like SAP, Oracle, IBM and Microsoft as well as by leading system integrators.

Portals, Business Information and Analytics, Knowledge Management, and Master Data Management should also be included in a DOM Interoperability infrastructure. Convenient access to a Master Data Management solution that supports a "single version of the truth" is basic to flattening of organizational boundaries. In the case of DOM this should include MDM for Asset information (like hierarchies, maintenance and inspection histories, etc.), OEM information related to those assets (like data sheets, safety and operating procedures, etc.) and Supplier data to facilitate efficient MRO procurement.

While it is not possible to calculate the exact benefits that an organization will receive from DOM Interoperability, “The World is Flat” demonstrates that the opportunities to improve performance through horizontal, collaborative business processes are essentially limitless. Other improvement initiatives, like Lean, have also demonstrated that improvement breeds more improvement. As changes are made, innovative people will see new opportunities that could not have been anticipated until the previous steps cleared their views.

NRX Asset Hub Meets the Challenge

NRX Global has a unique position with respect to DOM Interoperability. Software companies that provide applications for DOM functional groups



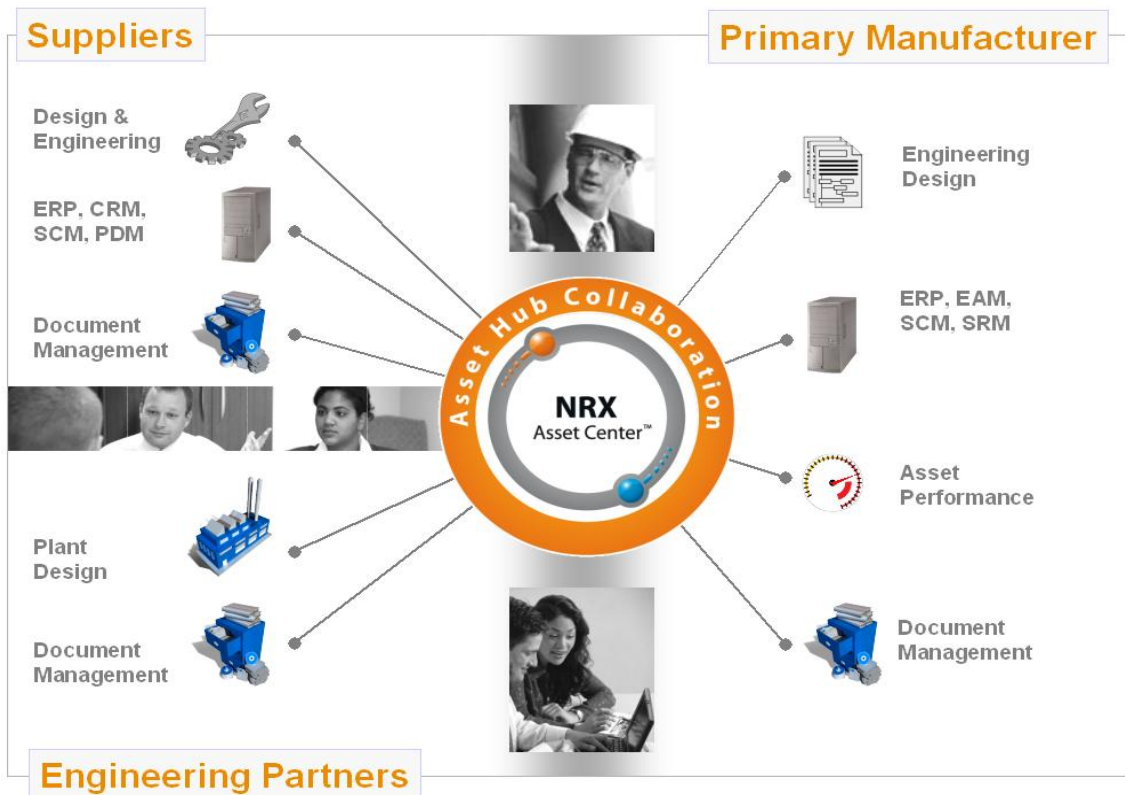
NRX Asset Master Data Management Model

Product Information Management

may also provide Functional Interoperability within that arena in order to improve productivity, but they do not address the broader DOM Interoperability issues discussed in this report. The NRX Asset Hub™ on the other hand, is specifically focused on the broader DOM Interoperability challenges and opens the door for companies to reap the significant benefits discussed above. Companies such as American Electric Power, Chevron and Bechtel are already leveraging NRX's Asset Information Management solutions to pursue DOM Interoperability and Operational Excellence.

The NRX Asset Hub™ enables Design, Operate and Maintain interoperability, and delivers a single view of asset information across the enterprise. It makes actionable information available to users and streamlines EPC and owner operator business processes by defining, collecting, transforming, deploying, and sustaining asset data from engineering companies, equip-

ment manufacturers and the plant community. This enables the whole asset lifecycle ecosystem to achieve DOM Interoperability. By automating the creation and management of a strategic asset information foundation, the solution underpins substantial improvements in enterprise-wide data exchange, safety, reliability, productivity, service management and MRO supply chain initiatives.



NRX solutions also enhance specialized mission critical applications at each stage of the asset lifecycle. Comprehensive asset information management provides value to organizations through the collaboration and staging of information among engineering companies, suppliers, and owner operator systems which eliminates the need for point-to-point integrations. And, this holistic approach to asset information management makes relevant information available to all users across the entire asset lifecycle.

NRX Global has found that their clients savings from use of Asset Hub can be as much as 1.5% of capital cost (i.e. \$15M per \$1B of capital cost) on the front end plus on-going annual benefits of 0.1% to 0.5% of asset value (i.e. \$1M to \$5M per \$1B of asset value).

NRX Asset Hub Methodology

The Asset Hub solution incorporates a robust, field-proven methodology for the scalable and repeatable management of asset information. This consists of five basic interrelated steps: Define, Collect, Transform, Deploy, and Sustain. First, a business owner *Defines* the asset information (and its structure/organization) required to support its business processes, like MRO materials management, MRO procurement, maintenance management, or service management. Information is then *Collected* from a broad spectrum of internal and external sources, *Transformed* into a form that can be easily consumed by users and their IT applications, and *Deployed* in an intuitive, role-based user interface (Deploy also covers the ‘deployment’ of the information into the appropriate business systems & transactions). Finally, purpose-built tools, workflow and a user feedback loop enable the integrity of information to be *Sustained*.



The NRX Asset Hub solution is designed for managing asset information throughout the entire asset lifecycle, from design and engineer to operate, maintain and retire. More specifically, Asset Hub is well suited to address the following challenges during the asset lifecycle:

- Capital project (new plant, new lines, new equipment) “information handover” from suppliers, engineering & construction partners, and service partners
- Cleanup and completeness of legacy asset information (equipment nameplate, equipment bills of material, material records, documents, etc.)
- Asset information/data migration (system consolidation, system changeover, etc.) driven by IT initiatives or corporate/plant acquisitions
- Establishment of a complete and reliable data foundation for reliability programs and proactive maintenance programs

- Rationalization of MRO inventory (elimination of duplicate and obsolete spares)
- Integrated centralized management of installed-base, customer asset information for improved service management.

The “Define” Phase

During the Define Phase, asset information requirements are precisely defined based on business objectives and user needs, and work breakdown structures, including resource and task assignments, are established. For example, a business objective could be to improve process safety management, increase maintenance efficiencies, increase plant reliability and availability, improve operational efficiencies, improve MRO procurement processes, etc.

Asset Hub support for the Define Phase includes:

- Definition of master data and document requirements
- Equipment identification, classification, criticality, scope
- Information specification and sources
- Template definition leveraging industry accepted data standards
- Repeatable and scalable work processes
- Project work management (task and resource assignment, scheduling) and workflow
- Project metrics, reporting and audit trail

The “Collect” Phase

The Collect Phase enables a user to manage the systematic collection of the defined documents and data from a broad spectrum of internal and external sources including software applications, IT systems and system repositories, electronic media, paper documentation and drawings, and physical equipment (nameplate, tags, barcodes, RFID, etc.)

Asset Hub support for the Collect Phase includes:

- SOA compliant, open architecture to facilitate access to relevant data and documents from multiple owner operator, engineering company and supplier applications, systems, repositories and servers
- Collaboration framework and data/document exchange
 - An “intelligent container” for the preservation of information “context” while sending and receiving asset information from system to system or application to application
 - Web-based portal for multi-party collaboration across internal functional areas and external suppliers and engineering companies

- Standard tag level data repository
- Universal mapping engine to map asset data/documents to asset registry
- Integration into corporate workflow engines
- Data management console
- Data and document collection and validation
 - Plant and warehouse audit tools
 - Plant equipment and warehouse material digitization

The “Transform” Phase

The Transform Phase transforms the data and documents into information that is relevant to specific users like process safety management coordinators, operators, planners, craftsmen, reliability and design engineers, construction and commissioning engineers, and procurement personnel. The Asset Hub’s hierarchical asset data model creates associations, or linkages, between asset information objects thereby facilitating the contextual delivery of relevant information to the user – in contrast to the user performing extensive searches for the information. Of particular importance to facilitating full Interoperability, during the Transform Phase the Asset Hub transforms originally authored information, such as design & engineering data, into predefined structures and formats that can readily be consumed by (i.e. directly input into with little or no manual intervention) end user applications such as service management, maintenance management, work clearance, and plant and equipment reliability applications.

Asset Hub support for the Transform Phase includes the following data/document transformation capabilities

- Standards, authoring, classifying, structuring, presentation
- Handover data model (creation of asset registry)
- Content assessment and quality assurance tools
- Digitize supplier content/ data (content conversion network)
- Associate content/ data with assets
- Associate content/ data/assets with supply chain (materials)
- Create Visual BOMs, task lists, work packages, maintenance plans

The “Deploy” Phase

The Asset Hub deploys the information to users in integrated, role-based views. This facilitates user adoption and ease of use by:

- Employing an intuitive, role-based workspace
- Delivering relevant information to users in the context of their workflow
- Deploying information into multiple business processes and transactions (project control, procurement, document management, engineering design, maintenance, reliability, process safety management, supply chain etc.)

The “Sustain” Phase

The Asset Hub provides a complete set of tools and workflow to facilitate the ongoing management of the asset information foundation to maintain its integrity, reliability and completeness.

The Asset Hub also provides a user-initiated feedback loop that engages all users in the process of asset information quality assurance. If the information that appears on a screen is known or suspected by the user to be of questionable reliability or completeness, the user can send a message directly to the content administrator or data steward detailing the suspected problem.

- Decentralized approach to sustaining content/data integrity (alerts) with central oversight and administration
- Status, reporting and feedback

Conclusions

NRX’s current offering is clearly noteworthy and addresses some of the most challenging DOM Interoperability requirements at the foundation, the information level.

We expect industry standards for Cross-Functional Business Process IOp and Business Network IOp to evolve and receive broad acceptance in the DOM community. Groups, like Fiatch, MIMOSA and ISO are already working to accelerate standardization of some of the most critical information exchange protocols. And, eventually, this will result in standard data models for many forms of DOM information. Owner/Operators need to consider this in their efforts to improve DOM performance and avoid investing too much in proprietary solutions that may need replaced. A strong feature of NRX’s approach to DOM is that they support any form of information storage and exchange. Therefore, investments in their technology are not considered risky. On the contrary, companies with an Asset

Hub™ environment should be well-positioned for rapid adoption of standards as they emerge.

Waiting is Not an Option

Certain facts emerge from this analysis and create a compelling case for all organizations to implement DOM Interoperability solutions:

- **Adopting DOM Interoperability is a pre-requisite not an option.**
 - The direct benefits of implementing Interoperability across DOM activities are documented and enormous.
 - The benefits from new, collaborative, horizontal business processes are expected to be even larger.
- **You will eventually need to adopt a Flat World mentality across your organization to remain a real competitor.** This includes
 - Educating management to understand and appreciate Flat World Benefits and Threats
 - Training people in Flat World concepts and encouraging them to use these capabilities to create new, horizontal, collaborative practices and drive step improvements in performance
 - Implementing multiple forms of Interoperability to flatten the DOM value chain and enable more innovative, collaborative business practices with all partners
- **Time is of the essence**
 - Those who adopt first will gain competitive advantage and take the lead in the optimization of DOM processes

Analyst: Sid Snitkin

Editor: Houghton LeRoy

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

API	Application Program Interface	ERP	Enterprise Resource Planning
B2B	Business-to-Business	IOP	Interoperability
BPM	Business Process Management	IT	Information Technology
CAGR	Compound Annual Growth Rate	MIS	Management Information System
CALM	Collaborative Asset Lifecycle Management	MRP	Materials Resource Planning
CMM	Collaborative Manufacturing Management	OpX	Operational Excellence
CNC	Computer Numeric Control	OLE	Object Linking & Embedding
CPG	Consumer Packaged Goods	OPC	OLE for Process Control
CPAS	Collaborative Process Automation System	PAS	Process Automation System
CPM	Collaborative Production Management	PLC	Programmable Logic Controller
DOM	Design, Operate, Maintain	PLM	Product Lifecycle Management
DCS	Distributed Control System	RFID	Radio Frequency Identification
EAI	Enterprise Application Integration	ROA	Return on Assets
EAM	Enterprise Asset Management	RPM	Real-time Performance Management
		SCM	Supply Chain Management
		WMS	Warehouse Management System

Founded in 1986, ARC Advisory Group has grown to become the Thought Leader in Manufacturing and Supply Chain solutions. For even your most complex business issues, our analysts have the expert industry knowledge and firsthand experience to help you find the best answer. We focus on simple, yet critical goals: improving your return on assets, operational performance, total cost of ownership, project time-to-benefit, and shareholder value.

All information in this report is proprietary to and copyrighted by ARC. No part of it may be reproduced without prior permission from ARC. This research has been sponsored in part by NRX Global. However, the opinions expressed by ARC in this paper are based on ARC's independent analysis.

You can take advantage of ARC's extensive ongoing research plus experience of our staff members through our Advisory Services. ARC's Advisory Services are specifically designed for executives responsible for developing strategies and directions for their organizations. For membership information, please call, fax, or write to:

ARC Advisory Group, Three Allied Drive, Dedham, MA 02026 USA
 Tel: 781-471-1000, Fax: 781-471-1100, Email: info@arcweb.com
 Visit our web pages at www.arcweb.com



3 ALLIED DRIVE DEDHAM MA 02026 USA 781-471-1000

BOSTON, MA | WASHINGTON, D.C. | PITTSBURGH, PA | PHOENIX, AZ | SAN FRANCISCO, CA
CAMBRIDGE, U.K. | DÜSSELDORF, GERMANY | MUNICH, GERMANY | HAMBURG, GERMANY | TOKYO, JAPAN | BANGALORE, INDIA | SHANGHAI, CHINA