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Closed Loop Quality Management: Integrating PLM and Quality Management

In recent Aberdeen research of over 500 manufacturers it was shown that 100% of Best-in-Class manufacturers having both a Quality Management solution and Product Life Cycle Management (PLM) have created real time interoperability between these solutions. In contrast, only 36% of Industry Average and Laggard manufacturers have done the same, making it immediately apparent that this approach to technology delivers significant value to companies having made the investment.

In this Analyst Insight we will characterize what it means to achieve Closed Loop Quality Management. We will then conduct a deep dive analysis on organizations with PLM and Quality Management interoperability already established. Discovering why they are so much more likely to achieve Best-in-Class performance and identifying what strategies, capabilities, and frameworks are supported by this interoperability. This Analyst Insight will then end with specific recommendations for achieving "Closed Loop Quality Management" through PLM and Quality Management interoperability.

Benchmarking the Value of PLM and Quality Management Interoperability

Previous research has already established that PLM and Quality Management interoperability has a substantive impact on an organizations' performance. In this new research we want to both quantify this performance improvement and answer the question of *why* does it improve performance. Quantifying the benefit is easy and is shown below, but answering why is a bit tougher.

One reason may be that PLM and Quality Management interoperability is a key technology enabler of Closed Loop Quality Management, which can be defined in the following way: A strategic framework aligning business processes and technology enablers to support quality management across product design, sourcing, manufacturing process planning, manufacturing execution, delivery, maintenance, and customer service. When these different business processes are properly aligned from a quality perspective, the organization can begin orchestrating processes across these traditionally disparate business functions, enabling the below business capabilities:

- Collaboration and bi-directional feedback between procurement, manufacturing, supply chain, customer service, and product development on key quality and non-conformance issues

- Visibility, control, and improvement of quality processes across procurement, product development, manufacturing supply chain, and service

- Enterprise-wide and integrated root cause analysis of non-conformances and quality issues across the develop, procure, make, and deliver business processes

In the following sections we will examine just how well organizations that have invested in PLM and Quality Management interoperability are achieving Closed Loop Quality Management, but to start the analysis, we will analyze how organizations that have invested in PLM and Quality Management interoperability compare in performance to organizations that have not. The metrics we will examine span multiple areas of any manufacturing organization and are listed below:

- **Overall Equipment Effectiveness (OEE) –** Composite metric measured as % availability x % performance x % quality

- **Successful New Product Introductions (NPI) –** Average percentage of NPI that hit time, volume, and quality targets.

- **Products in Compliance –** Percentage of total products produced in compliance with Government regulations, customer mandates, and Standard Operating Procedures (SOP)

- **Cost of Quality –** Measured as a share of revenue and includes: internal failure costs, external failure costs, prevention costs, and assurance costs

Cost of Quality Definition

Good Quality -

Prevention Costs - Arise from efforts to keep defects from occurring at all

Appraisal Costs - Arise from detecting defects via inspection, test, audit

Poor Quality -

Internal Failure Costs - Arise from defects caught internally and dealt with by discarding or repairing the defective items

External Failure Costs - Arise from defects that actually reach customers

Table 1: Performance Benefits of Interoperability

	Mean Performance
Organizations with PLM and Quality Management Interoperability	• 89% OEE • 87% Successful NPI • 97% Products in Compliance Cost of Quality: • 3% Internal Failure Costs • 2% External Failure Costs • 7% Quality Assurance Costs • 6% Quality Prevention Costs
Organizations without PLM and Quality Management Interoperability	• 84% OEE • 79% Successful NPI • 94% Products in Compliance Cost of Quality: • 7% Internal Failure Costs • 5% External Failure Costs • 8% Quality Assurance Costs • 8% Quality Prevention Costs

Source: Aberdeen Group, August 2010

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It is clear from Table 1 that PLM and Quality Management interoperability positively impacts metrics from a broad set of functional business areas.

First, these companies enjoy an OEE 6% higher than other companies, showing these companies do a better job of utilizing assets because of improved quality capabilities. These companies also enjoy almost 10% more successful New Product Introductions, showing the importance of quality on the NPI process. Additionally, these companies are producing approximately 3% more of their products in compliance with regulations, mandates, and standard operating procedures.

Finally, cost is significantly impacted be investments in PLM and Quality Management Interoperability. Companies with this interoperability established enjoy over 50% lower failure costs both internally and externally. At the same time, these companies are actually spending slightly less on their quality management systems due to reductions in manual processes and the consolidations of FTE's. When all is totaled, these cost reductions equate to almost 10% of revenue. In the next section we will examine how organizations with this interoperability established may differ in the strategies they are taking to improve quality.

Aligning Strategies and Technology Enablers

When the strategies manufacturers are implementing today are examined there are two major takeaways worthy of discussion. First, and most importantly, strategy and technology must align. This fact is most evident in the top two strategies being most highly adopted by companies with PLM and Quality Management interoperability. These strategies are both very well aligned to the strategic framework of Closed Loop Quality Management and the technologies needed to enable it.

The second takeaway is that there are still a large number of manufacturers focused on strategies that are generally tactical, like minimizing scrap or increasing response time to non-conformances. While these are important, they do not elevate the strategic importance of quality within the organization, which is the real key to success. Additionally, this lack of strategic focus is one of the greatest opportunities for quickly achieving a competitive advantage in the market place today.

Table 2: Strategic Actions

Strategic Action	Integrated Systems*	No Integrated Systems*
"Build in" compliance and traceability to production processes	62%	54%
Improve visibility and control of quality across product innovation, manufacturing, and supply chain operations	55%	41%
Improve the quality performance of critical suppliers	28%	19%

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Strategic Action	Integrated Systems*	No Integrated Systems*
Increase responsiveness to non-conformances	14%	20%
Minimize scrap, rework, returned materials and service costs	17%	34%

Source: Aberdeen Group, August 2010

*PLM and Quality Management System Integration

Making the above analysis actionable in regards to choosing a strategy, organizations have to ask themselves, "Do I see value in creating visibility and control of quality across product development, manufacturing, and supply chain operations" or "building in compliance and traceability to production processes", and if the answer is "yes" then commit to the technology that can support it. However, it takes more than just technology and strategy to deliver success. There is a whole set of needed business capabilities that support execution. Quality, fundamentally, has to change to be an integral part of the entire lifecycle, both for products and processes. In the next section we will examine these capabilities and how those that have invested in PLM and Quality Management interoperability are using them.

Business Capabilities Supporting Closed Loop Quality

Achieving Closed Loop Quality management takes more than a strategic initiative or technology implementation. It takes an enterprise-wide commitment to quality, a culture of operational excellence, and the requisite change-management for any organization to effectively leverage technology. The basis for this change management are the business capabilities any company has implemented and in the below table are the capabilities most well aligned with Closed Loop Quality Management, enabling the incorporation of quality management into the complete life cycle of products and processes.

Table 3: Business Capabilities

	Integrated Systems*	No Integrated Systems*
Business processes are dynamically updated as new best practices emerge	83%	33%
Quality data collected automatically across operations	86%	44%
Analytics are used to provide predictive insights based on the captured quality data	71%	36%

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	Integrated Systems*	No Integrated Systems*
Real-time monitoring of adverse events	86%	46%
Role based actionable intelligence is provided on key quality metrics	78%	28%

Source: Aberdeen Group, August 2010

*PLM and Quality Management System Integration

Companies with PLM and Quality Management interoperability are nearly three times as likely those without to make sure that standardized business processes are dynamically updated as best practices emerge. Establishing a standardized process is important, but it can also become a barrier to continuous improvement if these processes remain unchanged for a long period of time. Companies with PLM and Quality Management interoperability capture best practices to manage quality across the enterprise and are able to dynamically update these processes and implement them across operations. This enables the organization to be agile and flexible to changing internal (introduction of new products and processes) as well as external (government and customer regulations) needs of the manufacturing organization.

Automatically collected data is the foundation of any effective quality initiative. Paper and manually intensive processes maybe compliant and are sometimes perceived as less costly but they are prime sources for poor data quality and the inability to use quality data to improve decision making. Companies with PLM and Quality Management interoperability are nearly twice as likely as those without to be using automated data collection across the enterprise. This approach allows these organization to get much more value out of technology investments and improve performance, with direct and material improvements to the cost of quality.

The next three capabilities are all related and much more likely to be adopted by organizations that have PLM and Quality Management interoperability. With automated data collection in place, it can enable real time monitoring of adverse events, which is important for quickly addressing quality issues and ensuring that they are addressed as early in the process as possible. Another important capability is analytical tools, which enable decision makers with the ability to do more effective root cause analysis. Given the complexity of today's products, production processes, and distribution networks, it is often impossible to get to the real root cause with out a data driven statistical approach. Finally, role based visibility of quality issues is critical in any enterprise approach to quality management. Design engineers, manufacturing engineers, operations, and customer service all have very different responsibilities when it comes to quality and providing the right data to the right roles can greatly improve efficiency and collaboration.

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In the final analysis, these capabilities are all critical for creating Closed Loop Quality Management. Automated data collection, real time monitoring of adverse events, analytical tools, and role based visibility are all needed to foster the needed control, collaboration, and continuous improvement inherent to Closed Loop Quality Management.

Initiatives Supported by Closed Loop Quality

Companies that have achieved Closed Loop Quality Management are much more likely to have successful quality initiatives. Depending on the specific industry and competitive advantage of the firm, manufacturers will have different quality initiatives in place. Below are two common initiatives that many companies are focused on today.

Table 4: Business Frameworks

	Integrated Systems*	No Integrated Systems*
Design for Manufacturability - Design engineers have real time feedback from manufacturing operations allowing them to improve designs based on manufacturing performance.	79%	46%
Track and Trace - Design, Procurement, Manufacturing, Quality, and Distribution are integrated to create complete forward and backward traceability of products and processes.	76%	47%

Source: Aberdeen Group, August 2010

*PLM and Quality Management System Integration

As the above analysis shows, it turns out that those companies with PLM and Quality Management interoperability are much more likely to have these initiatives already successfully established in their business.

Recommended Actions

The following recommended actions will help companies achieve Closed Loop Quality Management and is associated with improvements in a number of key performance metrics for manufacturing companies

- **Identify KPIs that matter for your business.** Many companies today don't measure or don't even understand the cost of quality. This is a very important metric for benchmarking initiative's performance and improvements over time.

- **Highlight Closed Loop Quality Management as strategic initiative for your organization.** Every organization should benefit from putting Quality at the top of the CEOs agenda. Executives have only so much bandwidth and can have only a precious few true priorities. Companies with quality at the top of the list over and over again prove to outperform those that don't

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- **Support strategy and technology with proper business capabilities.** Automated data collection, real time monitoring of adverse events, analytical tools, and role based visibility are all needed to foster the needed control, collaboration, and continuous improvement inherent to Closed Loop Quality Management.

- **Invest in PLM.** Maturity in PLM is key capability for achieving Closed Loop Quality Management. It enables planning for key quality, testing, specification, and exception processes. It can also provide a platform for collaboration and communication between design and other key functional areas, like: procurement, manufacturing, distribution, and service.

- **Invest in PLM and Quality Management Interoperability.** Aberdeen research shows that this is a technology strategy highly correlated with Best-in-Class performance. It enables the elevation of quality management to an enterprise level business process transcending traditional functional areas.

- **Align strategy and technology investment.** Aberdeen research shows that the majority of top performing organizations align strategy with technology investments. In the case of Closed Loop Quality Management this means focusing on improving visibility and control of quality across product innovation, manufacturing, and supply chain operations. It is also important to avoid being to tactical with strategies. For example reducing scrap and rework should not be a high level strategy but rather just viewed as an out come of Closed Loop Quality Management.

Related Research	
A Platform Approach to Manufacturing Operations Management; 2009	The Cost of Quality; 2008
Authors: Matthew Littlefield, Senior Research Analyst, Manufacturing, matthew.littlefield@aberdeen.com Mehul Shah, Research Analyst, Manufacturing, mehul.shah@aberdeen.com	