Taking Enterprise Quality Management to the Next Level of Performance

Can you remember headlines in the news related to product recalls and quality issues? Did they change your buying behaviors? Do you hesitate when you buy food for your pets or toys for your children that were manufactured in certain countries? Are you a little more skeptical of the quality of certain car brands than you used to be? Prospective customers are closely monitoring the news and product reviews in social media before making buying decisions. News about quality problems quickly make their way to the headlines but news about improvements rarely do. The quality reputation of our brands is an important factor in buying decisions. It is not enough to be the low cost provider in today’s marketplace.

Over the last ten years, companies have been moving more manufacturing of subassemblies and critical components into the supply chain. The publicity and liability risk of product recalls, litigation, and regulatory penalties often fall on the end manufacturer even when root cause is eventually found layers down in the supply chain. The increasing dependency on key suppliers to deliver a quality product consistently to the market is driving leading manufacturers to evolve their practices and closely manage quality in partnership with their key suppliers. It is not enough to just trust suppliers to deliver quality, and manage them with simple reward and penalty methods.

The product’s value chain is now recognized as a business entity and process that needs to be managed—the value chain spanning the entire product lifecycle from engineering design to multiple suppliers, to manufacturing, to the hands of the customer, and aftermarket services and maintenance offered for the product. The risk associated with the lack of integration of quality assurance practices in the value chain needs to be managed more proactively.

Manufacturers want early visibility of problems arising downstream in the value chain so they can take corrective action as early as possible and minimize the potential impact. They need enhanced communication and collaboration processes with suppliers in order to track, follow up, and ensure continuous process improvement.

This paper describes a roadmap to mitigating the risks of the value chain by improving visibility, collaboration and orchestration of activities with suppliers—moving from reactive to proactive quality management, inside and outside the four walls of the organization. Current information technology solutions can help the organization achieve these goals without imposing unreasonable cost burdens on the enterprise and suppliers.

Organizations are not alone in dealing with these challenges. Approximately forty percent of manufacturers surveyed by Gartner in recent years are depending on their supply chain for over fifty percent of their product components. The roadmap presented is based on initiatives and lessons learned from leading companies in regulated discrete complex manufacturing industries including aerospace, defense and medical devices, but can be applicable to other industries where manufacturers must work closely with key suppliers.
Factors Driving the Need for Enhanced Practices

Factor 1 - Fragmentation of Quality Management in the Value Chain/Product Lifecycle

Outside of financials, there is no one business discipline that touches and impacts more of the organization than quality. Yet we rarely see quality managed as an end-to-end discipline overseen by one quality or compliance assurance department in the organization. It is still common for organizations to have different guidelines and business practices for managing their suppliers’ quality than the practices used for managing the quality of their internal manufacturing operations. The diagram in Figure 1 lists some of the typical quality disciplines spanning the product lifecycle. The departments, practices and systems involved in these disciplines are typically fragmented and should be evaluated by the organization for opportunities to increase standardization and orchestration of business processes.

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Figure 1. Typical fragmented quality information in the value chain
Factor 2 – Desire for Increased Visibility into the Value Chain

Companies want to have quality information available centrally in the organization instead of spread among functional islands. They also want to increase visibility of early warning signs in the supply chain to mitigate risks as early as possible. Surveys performed by Gartner in 2012 showed that a good percent of companies either have or are planning to improve visibility beyond production status. As illustrated in Figure 2, there is much interest in quality and test results.

![Companies Want More Upstream Visibility of Quality](image_url)

Figure 2. Percent of companies with initiatives to improve visibility to suppliers. Source: Gartner 2012
**Factor 3 – Drive to Faster Innovation and Product Introduction**

There is a shift in industry of mindset moving from efficiency focused initiatives to survive the down economy to innovation and growth driven initiatives to increase market share. This mindset shift is illustrated by the survey results in Figure 3. Why? Because the manufacturer that can launch new enhanced products to market quicker will have great competitive advantage as we move into an economy of recovery. Of course, this advantage only works if they can accelerate product introduction without sacrificing product quality.

However, propagating engineering design changes in the value chain can be a real challenge. It involves multiple departments and systems. Paper-based manual processes are usually slow and error prone. They can become a constraint to speeding up the implementation of revisions to product design throughout the value chain.

Many companies focus supplier quality efforts at their incoming inspection processes. However, many organizations cannot afford to wait until receiving inspection to start trouble shooting quality problems found in new product lines or product upgrades.

![Business Priorities Shift toward Customer Satisfaction and Growth Opportunities](image)

Figure 3. Business priorities have recently shifted. Source: Gartner 2012
Factor 4 – No Single Dominant Application for Enterprise Quality

As organizations evolve their quality management practices they quickly realize that many different applications are involved in their current quality management practices. How can organizations eliminate possible data inconsistencies and improve business process orchestration?

A tempting tactic for Information Technology (IT) departments is to try to handle all the required functions with a broad footprint software solution from a single vendor, but the reality is that it is hard to find a single commercial solution that is optimized for the entire enterprise. The single solution approach might solve some problems but cause others. It might impose constraints on the organization that prevent optimizing critical business functions. It is a more realistic approach and more flexible in the long run for the organization to work on standardizing a handful of key enterprise applications and develop standards for integration of these systems.

![Diagram of enterprise systems](image)

Figure 4. Typical enterprise systems involved in QA processes include PLM, ERP, MOM

Even though a single application for all business needs might not be a realistic strategy, the organization should still try to consolidate to a few critical enterprise-level applications instead of institutionalizing a proliferation of custom and commercial applications. It is typical for an organization in complex discrete manufacturing to end up with at least (a) a Product Lifecycle Management (PLM) system for engineering functions, (b) an Enterprise Resource Planning (ERP) system for financials, procurement and inventory control, and (c) a Manufacturing Operations Management (MOM) system to handle the manufacturing shop floor. Each of these systems has an important role in the overall quality management system and the organization must develop orchestration practices for business processes that span across them.

There is a risk of data inconsistency that needs to be mitigated across the different departments managing quality in the value chain. When each department has different data in separate systems and bring different perspectives to how they measure quality, the organization can end up working to different priorities in each silo. It is common to hear this concern phrased as a “duplication of data” concern, but data redundancy may be well justified between systems for performance and reliability reasons. For example, some manufacturing shop floors have to keep running efficiently around the clock (24x7) without risks of interruption because an integrated system, like Human Resources, has to perform a software maintenance process. The real concern should not be focused on the storage of the same number in two or more places; a real concern would be that different numbers might be
stored in different places. These risks can be mitigated if the organization (a) ensures one master system for each function, (b) defines consistent metrics across all systems, and (c) defines good integration standards between systems.

Important quality initiatives will be more likely to get funding if there is agreement in the organization on how to measure quality and prioritize projects consistently. Organizations are trying to avoid having different areas with separately prioritized lists of similar quality initiatives ultimately competing for a central corporate budget.

**Factor 5 – Requirements for Regulatory and Contractual Compliance**

The scope of compliance has been broadening in recent years to cover the increasing importance of the supply chain. Quality management standards in regulated industries have added clauses to specifically address the risks introduced by the increasing role of the supply chain. Even when organizations flow down quality requirements in contracts to their suppliers, the standards clearly put the ultimate responsibility on the manufacturer to verify quality for their customers.

For example, the recent Revision C to the AS9100 quality management standard for aerospace companies has added more emphasis on supplier and risk management. Organizations are required to: (a) define the various levels of approvals status for suppliers, (b) be able to demonstrate the logic used for making those decisions, and (c) define the process for changing the supplier status based on periodic performance assessments or triggers on events like defects, returns or corrective actions.

> **NOTE:** Customer verification activities performed at any level of the supply chain should not be used by the organization or the supplier as evidence of effective control of quality and does not absolve the organization of its responsibility to provide acceptable product and comply with all requirements.

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Roadmap to the Next Level of Collaboration

In leading organizations, quality and continuous improvement processes are an integral part of the enterprise business strategy and they include efforts into the supply chain. Leaders have elevated their supplier management strategies from a narrow focus on cost reduction to a broader collaborative spirit realizing that they must work closer with their suppliers to achieve the ultimate goal of launching better quality products to their markets quicker than the competition.

The four levels of supplier management strategies presented in Figure 7 represent an evolution toward collaboration observed among industry leading manufacturers and builds on that spirit to propose the natural next level (Level 4) of integration of processes across the value chain.

Figure 7. Roadmap to Higher Collaboration with Suppliers in Quality Management
Level 1 – Tactically Driven Supplier Quality Management

At level one, the supplier management efforts are tactically driven with a culture of urgency dedicated to putting out fires. The supplier management department spends a lot of time on the phone and on email expediting urgent shortages and resolving issues with suppliers.

Supplier quality is verified at the receiving inspection department. Parts may sit several days in receiving inspection waiting for inspection before they can move to inventory accessible to production.

Quality systems are usually not integrated at this stage. Engineering, Receiving, and Operations have their own quality teams working with their own applications.

Contract clauses include flow down of quality management requirements to the supplier. Suppliers are qualified and periodically audited via a formal supplier audit program. Supplier qualification processes can include certification requirements for industry Quality Management System (QMS) standards like AS9100 or ISO13485. Each supplier may also be rated and assigned a grade level like bronze, gold, or platinum, to reflect the stability and quality of the supplier. Suppliers with repeated issues will get demoted to a lower grade. Poor performance can also trigger penalty clauses in purchase contracts.

Level 2 - Efficiency Driven Supplier Quality Management

At level two, the supplier management efforts are efficiency driven with a focus on cost reduction. The organization reduces the number of suppliers and encourages suppliers to take on more integration responsibility for subassemblies. The first tier suppliers become integrators and many second and third tier suppliers move under them. Better pricing discounts can sometimes be negotiated with suppliers which are providing higher value integrated subassemblies.

At this level, the organization is tearing down walls that have traditionally segregated quality information in the organization. There is a focus on integrated business process management within the enterprise and a clear definition of the handoffs between departments and enterprise systems. Quality management processes like material review boards and corrective action processes are integrated across multiple departments including Engineering, Receiving, and Operations.

The organization also extends Lean practices to include the information value stream. The process improvements and integration efforts are not just wiring the old practices together, but rethinking quality management practices as an integral part of the manufacturing process—not something done alongside in a silo. As an example, traditional practices might have led an organization to separate management of supplier corrective actions, production related corrective actions, and facilities related corrective actions. These separate practices can be reevaluated and consolidated to allow the organization to better prioritize among all proposed corrective action initiatives based on a consistent risk and cost assessment process.

Quality practices are standardized across multiple company divisions. Efforts are made to benchmark across multiple divisions, talk the same language, compare metrics, and leverage lessons learned across the enterprise. The definition and calculation of metrics, like Cost of Quality and Cost of Non-Quality (a.k.a. Cost of Failures or Cost of Nonconformance), are reviewed and aligned across the organization to facilitate benchmarking.
Level 3 - Collaboration Driven Supplier Quality Management

At level three, the supplier management efforts are focused on increased collaboration with key suppliers. Traditionally issues were found at receiving inspection; instead more inspection responsibility is moved to the supplier site (source) in order to detect problems much earlier in the lifecycle. Receiving inspection inventory levels are reduced significantly. The amount of contract inspectors might be increased to perform more quality system and product audits at the suppliers’ sites.

The organization improves communication practices with suppliers. No longer relying solely on phone and email, but implementing formal two-way communications with suppliers. These communications are managed with a supplier portal accessible by the supplier via the internet and with a database behind the scenes maintaining traceability of all communications and the performance details leading to supplier ratings.

A single supplier rating number or grade level does not necessarily give a proper picture of performance for suppliers of multiple products and processes. With the help of information systems, suppliers can be graded for each product family and each capability instead of just one global rating for each supplier. The supplier might be better at some processes than others. There is no need to penalize a supplier globally if it is only having a problem in one product line or one process. Perhaps the supplier is doing really well in other processes. The more detail ratings establish a better understanding and facilitate better dialog for collaboration.

At this level of collaboration, many companies also establish programs to encourage and coach lower tier suppliers to implement more Lean Manufacturing and Six Sigma best practices. This collaboration level assists in lowering cost and reducing variability in product quality.

Level 4. Integration Driven Supplier Quality Management

At level four, organizations are working even closer with suppliers to bring the entire value chain to a new level of performance. Organizations are managing the challenge of purchasing subassemblies and components from suppliers throughout the world, but suppliers also have challenges. From a supplier point of view, the challenge is to deliver products to multiple customers with varying quality, oversight and communication expectations. In order to alleviate the burden on lower tier suppliers of supporting multiple customer demands it is necessary to standardize these practices so they can link their internal systems to customers instead of having to work with each customer’s supplier portal and a multitude of different communication requirements.

The focus at this level is to improve orchestrations of two-way business processes and workflow across the industry supply chain. Not just through portals, but through integration standards that link the native systems of each supplier to each immediate customer in the value chain in a way that enables information from multiple tiers down to flow upwards to the higher tier integrators. Orchestrated processes include coordinated workflows for planning, managing change and reaction to unplanned events.

Information technology and integration standards become essential tools for enabling this close tie of business systems in the value chain. Internal systems are enabled to publish and subscribe to web services with both customers and suppliers. These web services will require published integration standards and information protection schemes.
This is a relatively new frontier for quality management practices, but there are examples to learn from in other functional areas like procurement where standards exist for procurement processes over the web. Industry leading manufacturers, software vendors and standards organizations are diligently working on these standards and quality management must be part of this integration landscape because it touches all aspects of the value chain including procurement and contract management practices.
This level of integration must allow the organization to manage inspection requirements into the supply chain with similar processes to those used internally for manufacturing. Inspection requirements will flow from product engineering either to quality planners for the supply chain or manufacturing planners for internal operations. These standard formats must allow the product inspection specifications to easily be divided up by sub-components so they can flow down the supply chain to lower tier suppliers. Change management processes for these specifications must also flow down the supply chain.

Verification, testing, and inspection results must flow back from the supplier to a single repository in the organization for product genealogy and production history records that can in turn accumulate this information for an entire assembly (including subassemblies and components) and send it up the value chain to customers.

**Enhanced Practices towards Value Chain Quality Orchestration**

Some of the practices that organizations need to consider in order to achieve higher levels of orchestration in quality management across the entire value chain are listed below. These practices should be reviewed as part of the process improvement roadmap for the organization. Not as a one-time project, but as a journey to higher levels of performance through collaboration, integration, and orchestration.

**Practice 1. Promote a Collaboration Culture**

The culture of the organization must change to a collaboration culture. This requires the right mix of management skills in the supplier management team. A team that looks beyond lowering prices and rating suppliers—a team focused on working with suppliers as partners to create real win-win practices.

The organization needs a governance group for the semantics and data models that will enable effective exchange of information and metrics in the value chain. The governance responsibility is usually in the Information Technology (IT) department and requires team members with a collaboration spirit. The governance group should coordinate data exchange standards across all important enterprise systems and participate in the promotion of industry wide standards for the exchange of quality information in the supply chain.
Practice 2. Standardize Quality Practices across the Enterprise

Integration of quality metrics and sharing of best practices across the organization requires a common language for business processes and metrics. High level business processes like material review boards and corrective action processes can be defined in terms that align with industry regulations and clearly define the language and flow for information inputs and outputs between internal departments involved in quality management including Engineering, Receiving, and Operations. The organization’s quality manual and procedures should include these standard business process maps and definitions.

Practice 3. Integrate Information Systems within the Enterprise

Before the organization starts to reach into the supply chain with integration efforts, it must first make sure that the internal systems involved in quality management practices are already integrated. It is much easier to debug the information flow internally first. For example, the flow of quality management information interfaces between engineering systems and production systems should be ideally worked out internally first before the organization looks at how change management and corrective action practices will flow into the supply chain.

Internally among enterprise-level applications, standardization of integration interfaces can help define the business processes that cross the boundaries of the organization’s multiple departments and define how information will be exchanged between these processes. IT departments are leveraging technologies like Services Oriented Architecture (SOA), Web Services, Business Process Execution Language (BPEL), and Enterprise Service Bus (ESB) middleware to create a framework for business process management and workflow methods that bridge between key enterprise-level applications.
Practice 4. Increase Quality Verification at the Source

The costs of fixing problems found during final assembly versus fixing them at the supplier site can be five to ten times greater. In addition to the cost of filling out forms and the logistics of returning the bad part, there is additional cost of labor to take assemblies apart, fix the problem, and put them back together.

To implement earlier detection and resolution of quality issues, the organization can start doing more inspection processes at the supplier sites. These processes will need to be facilitated by an information system that can surface inspections via a supplier portal or implement interfaces to the suppliers’ native quality systems.

Efforts to move inspections to the source can greatly reduce levels receiving inspection inventory. Some companies have reported reductions of 75-90%.

Practice 5. Establish Integration Standards to link Suppliers and Customers

Initial improvements in collaboration practices into the supply chain can be done via a two-way supplier portal that allows an organization to post information and tasks for suppliers, and allows suppliers to respond remotely via the internet. Since this type of system would have a database backend to keep track of communications history and due dates, it a huge step forward over traditional pure phone and email methods. There is little chance of issues falling through the cracks if the system automates alerts based on lack of response or not meeting due dates.

The organization could also surface a customer portal and try to get the customers to use them, but customers are more likely to require the supplier organization to work with their own portals. In order to really achieve the next level of value chain integration, the supplier and customer must agree to integrate their native systems so each organization is only using one system that is able to publish and subscribe to many other systems in the value chain as depicted above in Figure 9.

The end goal is to allow each supplier to interact with each customer portal through standard integration interfaces so they can receive and send the information directly out of their native quality systems instead of having to manually reenter data into each customer portal in different ways. Even if the XML transmission to different customers needed a slight transformation or some custom fields, this would easily be achieved with currently available integration technologies.

One of the standard interface definitions required is the product’s bill of specifications. Since the organization needs to design in one location and manufacture in multiple locations in the value chain, it is necessary to clearly define a standard for transmitting these requirements among engineering and inspection systems. Figure 11 shows a few more examples of integration interfaces required to connect a supplier’s quality system directly to the manufacturing organization’s engineering and quality management systems.
Another important standard interface definition needed for quality integration is the *product manufacturing history record* which includes all the verification, testing, inspection data, and any deviations from design approved by engineering. For some organizations, the traditional way of putting together the history records that ship with the product or device can take a few days of collecting paperwork and filling in gaps. Having a system that receives the data directly from suppliers and accumulates all the data automatically into the required report can eliminate this clerical labor cost.

Current technologies are ready for this type of integration across the value chain including Services Oriented Architecture (SOA), XML Web Services, Business Process Execution Language (BPEL), and Enterprise Service Bus (ESB) products that can easily translate between slightly different XML formatted transmissions. Technologies like Secured Sockets Layer (SSL) are used to encrypt and secure the transmissions.

One current barrier that needs to be tackled is the lack of integration standards for quality management related data. There are mature standards for other types of integration in the value chain. For example, Electronic Data Interchange (EDI) standards are widely used for procurement transactions over the web connecting trading partners. EDI standards include transactions for quotes, purchase orders, invoices, shipping, and returns, but do not include quality management processes.

Standards organizations like OAGI (Open Applications Group) have mature XML standards for integrating enterprise systems and the supply chain and member companies are working to develop the standards needed to support quality management processes. This is a good time to get involved and help develop these standards.
Summary

To assure customer satisfaction, organizations must produce safe, reliable products that meet or exceed customer and regulatory requirements. The management of risks and demands in the highly distributed manufacturing environment requires more intimate collaborative and integrated business practices within the enterprise and the supply chain. Organizations can no longer afford to manage quality in multiple data silos and manage suppliers at an arm’s length. Organizations require more integration of enterprise systems to improve the efficiency of managing quality business processes proactively across the organization and into the supply chain.

The roadmap to improved value chain integration (Figure 7) is inspired on lessons learned working with industry leading companies that are achieving results with these types of initiatives. Leading organizations are somewhere between Level 2 and Level 3 of the process improvement roadmap. Some are looking at strategies for achieving Level 4.

There are information technology solutions available that can help organizations achieve higher levels of orchestration of quality business processes in the enterprise. This roadmap is meant to inspire organizations to develop their own roadmap for information technology enhancements that will lead to higher levels of performance in their product value chain.

Higher levels of collaboration in the supply chain can also be facilitated through participation in industry wide forums that promote standards for integrating processes across industry. Some of these industry and standards organizations include PISTEP, OAGI, EDI, Star Alliance, AIA, and ISA.

References


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Conrad Leiva started his career in Aerospace and Defense at McDonnell Douglas as a graduate of M.S. Industrial Engineering from Georgia Tech in 1986. Over the last seventeen years at iBASEt, Conrad has had the opportunity to work on optimizing the information flow between Engineering, Quality and Production disciplines with multiple Aerospace and Defense companies including Boeing, General Dynamics, Pratt & Whitney, Sikorsky, Gulfstream, DRS Technologies, Babcock & Wilcox and Portsmouth Naval Shipyard. Additionally, he holds certifications in MES/MOM Manufacturing Operations Management Methodologies and is a Certified Quality Auditor.

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