

White Paper



The Collaboration Imperative On Quality In Manufacturing

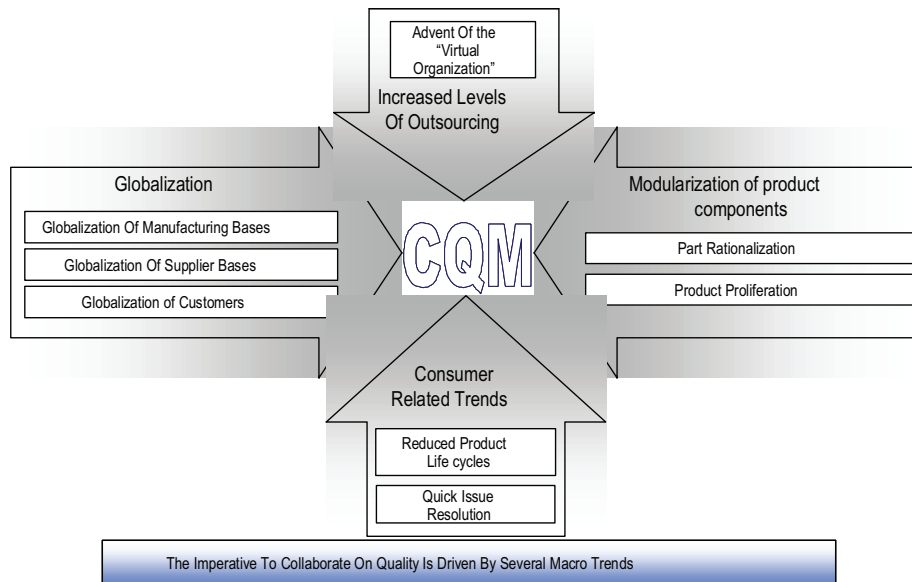
Abstract

The importance of quality in manufacturing cannot be overemphasized. The cost of quality is not confined to costs related to process assurance, product inspection, rework and rejects; rather it encompasses the impact on performance and market perception for the product and the corporate. In the new global economy, multiple entities collaborate to deliver a product to the end-customer. In such a scenario, the quality of a product is a determinant of the quality of the work done across the supply chain by myriad entities. The imperative today is to eliminate all non-value adding quality activities through innovative process or technological means. Information technology can play a huge role in ensuring that end quality is achieved through collaboration in quality assurance and quality management activities across the manufacturing supply chain. The authors examine the enormity of the quality problem, provide a framework to ascertain the maturity levels of industry responses, put forward a transitioning methodology and illustrate a case of how IT can enable the entire process.

Managing Quality In The Emerging Manufacturing Environment

Quality as a function has played a pivotal role in the highly competitive manufacturing environment. The significant consumer shift in the US from the local auto majors to the Japanese ones during the 80s has shown how quality can generate significant competitive advantage.

Managing quality effectively has been a key determinant in an organizations' pursuit of lower total costs and increased customer satisfaction. In earlier days, quality challenges were pre-dominantly specification or process led and linked to equipment being unable to produce components and products of quality desired by customers to a desired specification in a reliable fashion. This was largely an enterprise challenge and was tackled as such. Today's challenges are very different. The quality of a product today depends not only on the activities carried out on it within the enterprise but also at every stage in the value chain.



The supply chains of today are many tiers deep and need to work in an integrated fashion. To substantiate, let's look at some of the macro trends in manufacturing in the past few years:

Trend # 1: The Impact Of Globalization: Consumer markets are no longer fragmented and localized, supply bases have expanded and manufacturing is done based on cost-economics. The consequent impact on managing quality cannot be understated.

- Globalization of manufacturing base: Cost considerations have driven outsourcing and offshoring of manufacturing operations, resulting in the creation of manufacturing bases all over the world. Globally, organizations are struggling to establish a unified, structured process for management and resolution of quality issues. Similar product families are being manufactured at facilities spread across the globe. Situations arise where quality issues resolved in certain geographies remain issues in others. The implementation of correction/corrective action is becoming harder to coordinate and could result in cases where the same customer is sent batches of varying quality.
- Globalization of supplier base: Coupled with globalization of manufacturing facilities has been the trend of supplier base globalization. Today, manufacturing a single piece of apparel requires several suppliers across continents, which need to collaborate to deliver the product on time and within specified quality parameters. Working with this intercontinental chain of entities to unravel the genesis of a quality complaint can be truly mind-boggling. Not to mention the number of iterations that are often required before a complex issue is resolved.
- Globalization of customer base: Saturation and low growth prospects in developed markets are prompting companies to explore new untested markets. Consequently, quality managers need to grapple with the issues that range from geographical distance, disparate quality standards to cultural heterogeneity.

Trend # 2: Increased Levels Of Outsourcing: As the "virtual organization" moves from the realms of fantasy to reality, more and more non-core operations are being outsourced. Hence, quality control processes that were earlier predominantly inward looking are today dependent on the wider value chain to a much greater extent. A good example is the personal computer manufacturing industry that often relies on its suppliers for up to 80% of the product's bill of materials cost.

Trend # 3: Modularization Of Product Components: Rationalization of parts and components driven by a need to manage product proliferation and ever-increasing complexity has resulted in the trend to modularize and do a plug and play. A typical auto component can find its way into products that run across categories. For example, a leading Japanese car manufacturer uses the same Sun-visor holder – a small plastic part into which the sun-visor is usually snap fitted - for a sports utility vehicle, an economy car and a light commercial vehicle. The vehicles are normally assembled by product line across various manufacturing facilities. A problem in the component needs to be propagated for resolution across product portfolio and manufacturing facilities

Trend # 4:Customer Related Trends:

- Lengthening of warranty periods: Driven by a need by companies to differentiate overall service offering and improve customer confidence in product's quality, consumer durables are witnessing extended warranty and post sales service agreements. This necessitates a considerable enhancement of product quality management horizons.
- Reduction in product lifecycles: Organizations today have a much shorter window of opportunity within which to introduce a product and book profits. A critical quality problem that paralyses the value chain for any significant duration of time and takes away customer confidence in the product can be catastrophic. This places emphasis both on the delivered product quality as well as the after-sales service.
- Increased emphasis on quick issue resolution: In addition to the changing perception of good product quality as only a hygiene factor, service quality is assuming critical dimensions as a means to differentiate. Convenience and responsiveness on product service issues needs to be assured.

All this adds up into a need for quality assurance and control processes that can meet the challenges that the macro environment has thrown at it in the form of above trends. The complexity in meeting these challenges is heightened by the sheer number and variety of entities stakeholders involved.

The Stakeholders Are Numerous And Across The Extended Enterprise

1. **Intra-organization:** The quest for making high quality products leads to several departments joining hands together in the pursuit of this goal. A typical quality problem has multiple initiation as well as touch points. First information could come in from the shop floor or quality control or procurement. Even finance departments have a role to play, since poor quality could have both short term and long term financial implications. The key functions involved are:
 - a. Manufacturing
 - b. Product Development
 - c. Information Systems
 - d. Supply Chain Management
 - e. Production Engineering
 - f. In-house test labs
 - g. Customer service
 - h. Accounts Payables/Receivables
 - i. Quality Assurance
2. **The Extended Organization:** In today's scenario where traditional methods of policing-for- quality are being replaced by quality ownership, every link in the value chain has an important role to play. In the case of a major auto manufacturer, a wrong mix of woods (to be later used for making hardboard based components) resulted in severe quality problems six months later when the cars in which the relevant components was fitted had to endure high moisture tropical environment. The specifications had to pass through 3 links in the value chain from the car manufacturer to the lumber supplier.
3. **Independent test agencies:** The testing results obtained from independent unbiased test agencies are often regarded as the "Holy Grail" in whom both customers and suppliers trust when trying to resolve tricky issues. Many a quality issue lands up with these agencies.
4. **Other supply chain partners:** The advent of outsourcing has resulted in even critical functions like design and logistics being managed by external entities. In such an event, designing for quality and for product management needs to be managed in a collaborative paradigm.

5. **Service Agencies:** Service agencies are a primary consumer of product design data and take the primary responsibility for ensuring a good service quality experience to the customer. Any changes in product specifications or service procedures need to be published to all service agencies for speedy and efficient management of service requests. A service problem report could be the basis for a large-scale product recall. Hence service quality becomes a key link in the Total Quality Management process.
6. **Retailers and customers:** They can have unique needs depending upon product usage and environmental conditions. They are the most important players as the very existence of the value chain is dependent on their satisfaction.

Collaboration Is The Answer

We have seen how the complexity in resolving a quality issue is driven not just by the changing dynamics of the industry and the consumer, but also by the involvement of a whole range of intra as well as inter-organizational entities in the resolution process. The optimal solution would need to be essentially collaborative and cater to the needs of each of these. It would also need to channel the industry response to quality management in order to take it to the next higher level.

Different Industry Responses To The Quality Challenge

Different organizations and supply chains adopt differing strategies towards the same business issue. The same is true in the case of organizational approaches towards managing quality too. Organizations exhibit differing stages of maturity vis-à-vis collaboration towards quality management. While, the quality management practices followed by most organizations would fall across the 3 stages shown below, the imperative is for transitioning towards “evolved” status on each element on a supply chain wide basis.

TABLE 1: THE STAGES OF INDUSTRY RESPONSE TO MANAGING QUALITY			
Stage =>	Elementary	Maturing	Evolved
Relationship Mode	Coercive (Driven top down.)	Co-operative	Collaborative
Philosophy	Enforcement	Quality Assurance & Quality Control	Empowerment – Total Quality Management
Driving Force	Meet product and process specifications.	Process adherence – control and manage variability	Design for variability. Process adherence – control and manage variability
Functional Status	Inspection & Testing group	Quality Assurance group.	Organizational scope. Total employee involvement.
Quality Metrics	Product metrics such as number of rejects, rework costs; etc.	Product and process metrics	Product, process and cost metrics such as Total Cost Of Quality.
Partner Visibility	Low visibility – insulated function.	Medium – documentation standards and document exchange.	High – defined processes with high level of automation and real-time exchange of quality data.

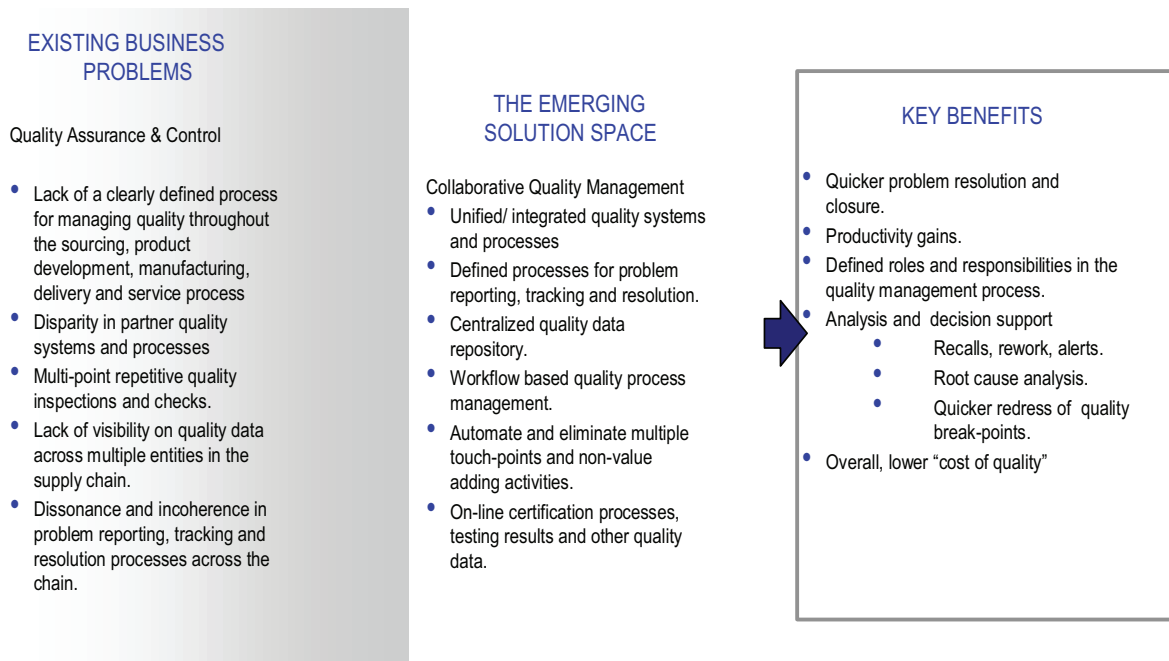
An organization that is “Evolved” would need to exhibit several key characteristics – collaborative, organizational empowerment, quality ownership, advanced quality metrics that tie into business performance and high level of automation in the quality systems at the planning and execution levels. This can be achieved by adopting measures to achieve effective transition from one maturity level to the next.

Devising the Transition For The Quality Challenge

The manufacturing paradigm has changed and quality practices are undergoing metamorphosis. Transitioning from one level of maturity to a higher level would call for changes that would be related to the organizational structure, business processes and the supporting technological infrastructure. Such an initiative that has far reaching ramifications would need to undergo a logical change process, the key steps of which could be:

- a. Build organizational conviction and articulate the need to change
- b. Provide a communications network for the change exercise.
- c. Assess the current state of the enterprise and its partners
- d. Design and illustrate the desired state
- e. Manage change and start implementing the new process
- f. Ramp-up and monitor adequately till process stability is reached
- g. Continuous Improvement programs

The exercise would need to target existing business problems through innovative solutions to generate business benefits that are tangible and quantitative.



The following quality management attributes for a collaborative framework would be most important in carrying out the transition exercise:

- Buy-in from all the stakeholders.
 - Within the enterprise.
 - Across the extended enterprise.
- Visibility on quality related activities within the enterprise and across the supply chain.
 - Early visibility into inspection and testing results.
 - Quality certification on-line.
- Efficiency of issue tracking and resolution.
 - Defined problem resolution paths.
 - Defined monitoring and control procedures.
 - Preventive/ remedial action initiation.

- Collaboration and synchronization on quality efforts.
 - Elimination of repetitive tasks.
 - Defined collaborative interfaces.
 - Concurrency of efforts vis-à-vis sequential flow.
- Speed and agility of response to quality challenges across the supply chain.
 - Analysis and decision support.
 - Centralization of quality data and documentation.
- Well-designed workflows and process management.

The Enabling Role Of Information Technology

Given the set of entities that need to collaborate with each other in a highly complex environment, Information Technology can today offer solutions that can help organizations in their transition towards evolved quality management practices. The focus would be to enable cross-functional and cross-organizational teams to work together in an environment that enables partner visibility and real-time responses. Workflow management would assume great significance for managing the complexity in the quality issue resolution process, which spans multiple entities and functions. Centralization of quality data and global access to it would drive analysis, decision support and pro-active action in the most balanced manner.

A Model For IT Enabled Collaborative Quality Management (CQM)

Quality has multiple facets – e.g. product quality, process quality, service quality, etc. Manufacturing companies and their supply chain partners manage quality across all these facets. In addition, quality problems come in various sizes and shapes from the most mundane to the most complicated. On the simpler side, a quality service request could be a product rejection on attributes or on dimensions due to logistical mishandling. On the more complicated side could be a field failure of equipment whose components come from hundreds of vendors and undergo multiple process steps. For example, a defective gear could result from the process and materials used by anyone or more of the steel supplier, the forging vendor, and the gear cutting plant, the surface coating plant or the assembly shop. And what if an entire batch of gears is found defective? How do we manage recalls and initiate the proper service action even before more field failure reports come in? Traceability and issue resolution in such environments could be long arduous tasks. IT can play a crucial role in such complex scenarios.

To set the context, let us look at the key elements (Refer Table 2) of a quality issue. Each of these elements can take a dimension at either end of the spectrum or somewhere in-between.

TABLE 2: KEY ELEMENTS OF A QUALITY ISSUE		
Measure =>	Low	High
<i>Business Criticality (Problem Scale)</i>	Does not hit business operations (Continue with deviation approval - corrective action planned and scheduled.)	Business Operations are threatened. Immediate fix needed.
<i>Frequency Of Occurrence</i>	Isolated incident	Repetitive
<i>Resolution Complexity</i>	One time correction	Extended research and corrective actions
<i>Cost Of Redressal</i>	Minor	Major costs (Overhaul/Opportunity costs of machine down-time)

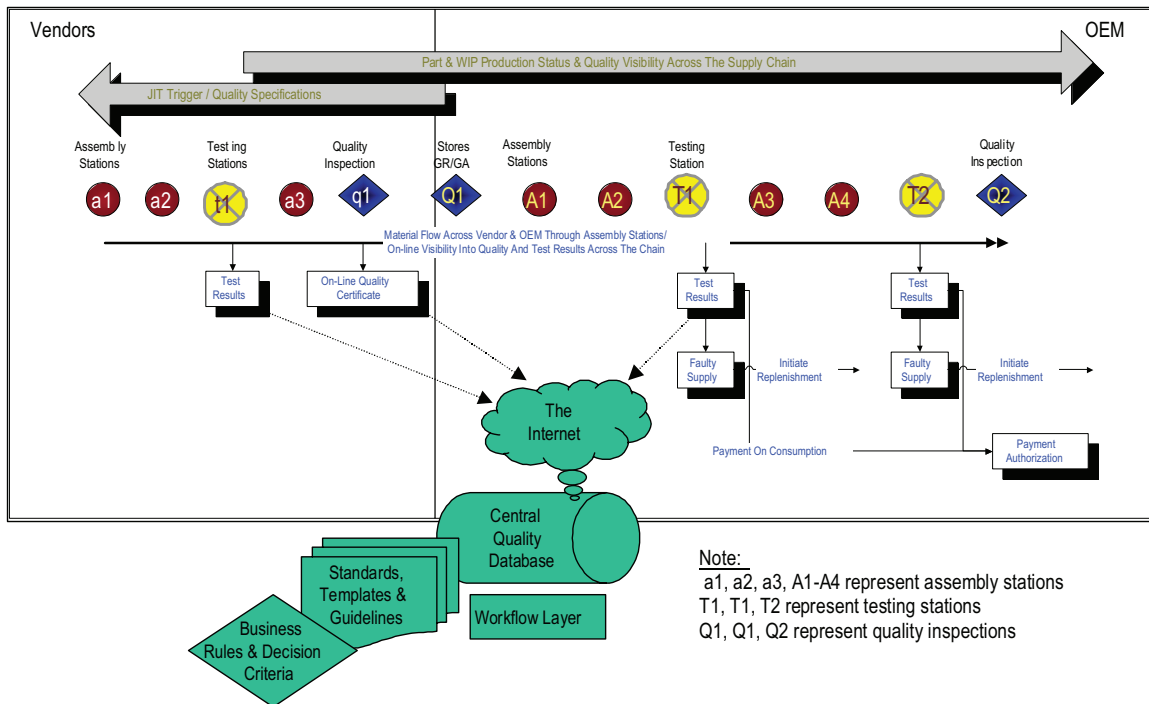
Keeping the above context in mind, let us examine a model that enables Collaborative Quality Management in a manufacturing supply chain environment.

Collaborative Quality Management In An Integrated Product Development, Testing, Certification And Servicing Process

A multi-entity supply chain needs visibility in its partner processes not only in terms of planning, forecasting or inventory data but also in processes that are more operational in nature such as WIP (Work In Progress) status, quality test and inspection results, quality certification etc. Quality processes typically would need to be governed by standards and document templates that are acceptable to all the entities.

What could be the various quality assurance and control activities that can be done on-line?

A simplistic scenario provided in the diagram is illustrative of a few such activities. As demonstrated in this scenario, a central quality database can support myriad legacy applications in managing quality. This can be accessed through the net. It can be effectively leveraged by using business rules and decision criteria that would help providing adequate attention to the issue at hand. Standards, templates and guidelines would help gathering the data in a structured and efficient manner. A workflow layer can route the CQM process through the appropriate internal/external entities.



In the example above, a CQM solution could help in two ways:

- Business Process Change** – Use concepts like “Payment On Consumption”. Conventional processes trigger off payment to vendors based on an acceptance check at the point of goods receipt. Large lot supplies normally go through sampling procedures. These can result in a bad lot being accepted and vice-versa. Additionally, there would be a cost of recovering payments for bad supplies. A delay in the payment trigger based on assembly/ consumption of that supply could eliminate the entire process of payment recovery and adjustment; at the same time it could impose greater responsibility on the vendor to supply good components. The need for such a process would be the front-end business partner agreement and of course the integration of the testing stations with the financial systems for triggering payments.
- Technological Innovation** – Use the web to get real-time visibility. The test data and the quality certification data could be hosted on a central quality database that could provide real-time visibility into the quality of parts manufactured at the vendor end. Consequently, the reaction time or responsiveness of the OEM (Original Equipment Manufacturer) could be considerably enhanced with respect to any quality deviations, non-conformances etc.

The scenario could be extended to other CQM activities through the product’s lifecycle.

A) Product Development related activities:

Product development is often a long drawn process involving much iteration in coming up with a product that closely meets customer requirements. Managing quality in this process is a major challenge due to the involvement of multiple entities and frequent modifications in specifications. The need of the hour is:

- c. Transparent and real time sharing of specifications – original as well as modified
- d. Workflow enabled sample approval process with sufficient visibility to the stakeholders
- e. Project management functionalities to enable quality related complex product development activities

B) Quality issue resolution related activities:

As discussed earlier, different quality issues have differing resolution needs and drivers. An effective IT solution would be one that can optimize the balance between functional depth and coverage. The model proposed would be able to tackle both the routine, non-critical issues as well as the most complicated ones. It would be need driven and have sufficient intelligence to manage workflows efficiently. On the whole it should:

- a. Support stakeholders to effectively collaborate through robust workflows
- b. Provide historical information for knowledge reuse
- c. Clearly identify roles and responsibilities
- d. Provide visibility to resolution process
- e. Monitoring and escalation mechanisms to improve effectiveness

C) Product Servicing related aspects:

Servicing of a product in the field places some unique demands an IT solution. In this model we propose that the CQM solution should be extendible to the customer site. It needs to support the servicing cycle and impart a sense of efficiency in service execution. Broadly it should support:

- a. Immediate reporting of problem to the stakeholders so that quick measures can be taken to prevent further defective products from reaching customers
- b. High level of visibility to customer not just on analysis status, roles etc but also on how quickly the piece of equipment is likely to be up and running. This may need access to supply chain applications.
- c. Effective dissemination of maintenance knowledge, drawings, parts ordering capability to service engineers who are located far from corporate networks

D) Creation, control and sharing of quality documentation and certificates:

Documentation and reports are important not just for the sake of acquiring/retaining ISO or QS certification but also for providing the basic TQM tools for each entity in the supply chain. An optimal solution needs to support development, storage and sharing of the following:

- a. Non-conformance reports
- b. Deviation reports
- c. Standard inspection and testing guidelines
- d. Clearance certificates.
- e. Creation and sharing of Test and inspection reports.
- f. Generating quality analysis reports – problem root cause analysis and defect prevention activities.
- g. Create and manage quality control plans. Manage quality audits and their results and findings.
- h. Track and manage problem reports and issues from genesis to closure.

E) Impact On Partner Processes:

Another possibility of CQM lies in the collaborative impact on partners. Identification of flaws and loopholes in supply chain partner processes and their subsequent remedy could lead to supply chain improvements and reduction in total cost of ownership.

The CQM model needs to support the management of quality in a collaborative supply chain environment such that the key elements for a quality issue (Table 2) are addressed.

The key to the success of the model is the degree to which it is able to tackle internal as well as external challenges in the new manufacturing supply chain environment.

TABLE 3: THE CQM MODEL WOULD ADDRESS MOST QUALITY CHALLENGES						
Needs	Chiefly met by model characteristics (✓)					
	Real Time Visibility	Monitoring /Escalations Mechanisms	Central Data Access	Document Management	Workflow Management	Analytics & Decision Support
↓ Trends						
Globalization	✓	✓	✓	✓	✓	✓
Outsourcing	✓	✓	✓	✓	✓	✓
Modularization	✓		✓	✓	✓	✓
Consumer Trends		✓	✓		✓	✓

Concluding Remarks

In the new global economy, multiple entities collaborate to deliver a product to the end-customer. In such a scenario, the quality of a product is a determinant of the quality of the work done across the supply chain by myriad entities. The imperative today is to eliminate all non-value adding quality activities through innovative process or technological means. Information technology can play a huge role in ensuring that end quality is achieved through collaboration in quality assurance and quality management activities across the manufacturing supply chain.

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