



Quality Planning as a Competitive Advantage

Vertically Integrated Quality

A QAD Leadership White Paper for the
Global Manufacturing Industry

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QUALITY PLANNING AS A COMPETITIVE ADVANTAGE

KEEP YOUR EYE ON THE BIG PICTURE

Manufacturers that don't actively plan for and address the accelerating pace of change – whether technological change or other, often unpredictable disruptions – will lose ground to competitors at best or cease to exist at worst. Everyday operational challenges, though, can distract from critical longer-term vision.

Similar to sports, a team without strong fundamentals will always be on its heels and rarely have the chance to make that game-changing play. Quality is one manufacturing fundamental that demands attention.

A vertically integrated quality system is defined as the integration of processes that contribute to the manufacturing of a product. It starts with the initial phases of the new product introduction and moves all the way through functionality covering the management of product that has already been put into use at the customer. These processes can include:

- Ideation / product conception
- Feasibility
- Product design
- Design validation
- Process design
- Process validation
- Program management
- Sourcing and supplier management
- Prototyping
- Customer / regulatory approval
- Launch / production
- Monitoring
- Continuous improvement / corrective action

With all these processes, there will be costly breakdowns if systems are not set up properly. Systems need to be set up to transfer outputs of one process into inputs to the next process to ensure that the transfer actually happens, and that it's timely, accurate, and efficient.

This paper focuses on:

- Understanding where the costs usually originate, and shining a light on very significant costs that we rarely take into account
- How improving planning can make an appreciable impact on these costs
- How effective systems can help improve communication and enforcement of these plans

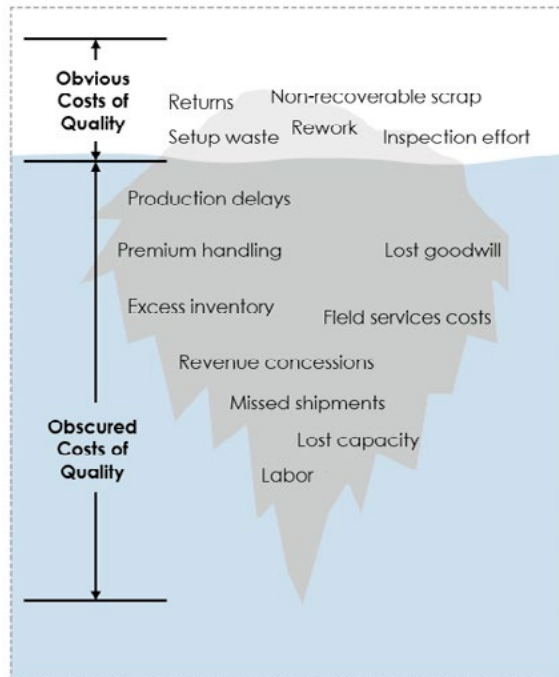
COST OF QUALITY EXCEEDS WHAT CAN BE MEASURED BY THE WEIGHT OF YOUR SCRAP BIN

Nearly every manufacturer can produce a report with details around scrap rates and associated costs. The parts in the scrap bin are a highly visual quality measurement. There will also be identifiable costs associated with a continuing series of reactive quality investigations into process variation and identifications of root causes. All of this is necessary quality-based blocking and tackling.

In most cases, the less obvious costs of quality far exceed what can be measured in the weight of the scrap bin. Figure 1 depicts the classic portrayal of the obvious costs of quality as only the tip of the iceberg. In many instances the cost of the parts in the scrap bin are less than 10% of the overall cost of quality.

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Figure 1. Hidden Costs of Quality



The less obvious costs include, but are not limited to:

- Cost of quality verification – inspection material and personnel that are engaged continuously as part of operations
- Cost of quality documentation management – product customization puts a strain on traditional document management
- Cost of rework and scrap remediation
- Cost of quality investigations and research
- Management of version control and associated verifications
- Training coordination to ensure operator capability and accountability
- Alignment effort with product development for quality design and manufacturability

- Alignment with product development around nonconformance as the basis for continuous improvement
- Premium freight associated with responding to quality-based product replacement

These costs are further accentuated by business risks once product quality issues become externalised. Quality issues identified after a manufacturer ships product to customers result in costs associated with returned material and rework or replacement. Frequent product quality returns often result in a reactive increase in inspection and costly nonconformance prevention efforts. These quality issues also put future revenue and profit at risk. Repeated quality issues may require concessions on price and will make even the most loyal customer seek an alternative source of product.

A FAILURE TO PLAN . . .

Of course, quality rarely just happens. It's not easy. Manufacturers must engage in numerous planning activities which include:

- New Product Introduction (NPI)
- Design – planning for quality / DFMEA, reliability, assembly, maintenance, etc.
- Raw material and subcomponent / sourcing and procurement
- Process flow and monitoring, risk planning / PFMEA, control plans
- Tooling requirements
- Receiving inspection
- Post-production concerns

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An integrated quality plan almost always revolves around the development and management of the supporting quality documents. Nearly every quality-based activity has some level of documentation. In an increasingly dynamic manufacturing environment, systemic management of the myriad documents is critical to quality.

QUALITY PLANNING

- Document management
- Alignment with product design and revision control
- Supplier management and sourcing
- Material evaluations and management
- Production specifications: equipment and product
- Operational specifications

In this context, the term “document” is used in the broadest way. These documents can range in format from detailed product drawings, simple work instructions, critical specifications, inspection directives and even short videos that provide instructions on inspection or processing steps. The management of these documents and the associated information nearly always involves multiple manufacturing applications and supporting systems. System implementation decisions drive the vertical integration of these systems and correspondingly, the effectiveness of the supporting document management.

Even the most basic example of vertically integrated quality can drive significant benefits. The definition of the product and associated quality plan starts in engineering and may include a formal Product Lifecycle Management (PLM) system or may be based on well-defined standard operating procedures (SOPs). The quality plan data in these designs includes the definitions

for part quality in terms of physical dimensions, weight and other potential inspection values. Too often this data must be manually transposed for use in execution systems. This manual transposition is a potential point for human error and overall system delays.

Automated document management should be a foundational element in vertically integrated quality. This is true of both quality planning documents and the documents and records identified in the plan that will be used during execution. The vertical set of systems can include the passage of documents or associated values from a PLM/SOP to an ERP system. The documentation management would then also include the integration of quality information to the QMS from the ERP or directly from the PLM/SOP.

Often there are incremental data structures and definitions that are added to the core data and managed in parallel at the ERP and/or QMS level.

The key is that the quality planning function lays the foundation for this vertically integrated information. Document management allows for this information to be the backbone of a vertically integrated quality system.

It is important to recognize that document management is critical in two distinct ways:

1. The effective vertical integration allows for multiple systems and organisational functions to share a common view of the source of this information. A vertically integrated system removes the recurring questions on the plant floor about where to find a drawing or the details necessary to produce a product. This cross-functional quality plan alone can have a dramatic impact on the effectiveness of the quality aspects of manufacturing.

2. Quality data issues are further exacerbated when products have frequent revisions and

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changes. Competitive pressure and market demand can cause frequent product revisions and rapid introduction of new/changed product, which is the new normal for many manufacturers. Mass customization has resulted in many manufacturers making products or SKUs that are unique to a single customer.

Although each product may be a variant of a basic item, the quality inspection data may vary for each production order. Systemic approaches to document management at this level of variation may be the only way to effectively handle these types of environments.

Quality planning also includes the documentation associated with supplier management. Each product is based on a set of raw materials or sourced components.

A vertically integrated quality plan can be combined with sourcing systems to drive supplier performance metrics and incoming quality inspection requirements, manage supplier provided quality certifications and much more. Automated planning and documentation can provide significant benefits in terms of material evaluation and collaboration with suppliers around both production demand and quality expectations.

An integrated quality plan includes the specification that will be used by Quality Control (QC) and other quality execution efforts. These specification values can include production specifications like machine settings and product dimension tolerances. They can also include operational specifications such as equipment qualifications, operator training certifications and product sampling rates. All this information can be managed across a single vertically integrated quality system that may include PLM/SOP, ERP, MES and QMS.

Finally, the management of the quality plan and its

associated documents must also include security over document control. In most cases, quality planning and quality execution documents are considered “controlled” materials. Only selected individuals will be authorised to make document modifications. This level of control will be supported by an approval workflow for reviewers and cross-functional personnel.

In certain industries, the overall management of the quality planning process is identified as the Production Part Approval Process (PPAP), which manages the process from design through production launch. The concepts of PPAP can be expanded across industries and be the basis for long-term support of quality initiatives within the manufacturing environment.

QUALITY RECORDING AND REPORTING – THE CLIPBOARD IS NO ONE’S FRIEND

The vertical integration of quality planning and quality operational execution activity becomes the foundation for integrated quality data recording and correspondingly, reporting. When data capture activities are separated from the system with quality operational definitions, there are many opportunities for human error, data inaccuracy and invalid history records.

The definitive example for disconnected quality data recording is the line-side clip board. The manual clipboard is no one’s friend in a manufacturing environment. Most floor level operators perceive the clipboard and the manual recording of values as low priority tasks and the quality / integrity of the collected data reflects that attitude. Clipboard data is infrequently collected and the aggregation of that data into spreadsheets often results in charts and metrics of little value.

Vertically integrated quality recording starts with the contextual checking of expected and

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acceptable data ranges. The data recording is immediately associated with the quality plan and the connected dynamic data sets, including equipment settings, current operator and specific timestamps. The automated collection of quality data and the contextual access to the data result in tremendous opportunities for impactful analysis and reporting.

The automation of vertically integrated quality data provides the basis to address most of the hidden costs of quality. Structured evaluation of equipment performance, product yields and sources of variation result in improvements in product quality and improved customer service levels.

Vertically integrated quality information can make a significant impact on the response to post production quality issues. Manufacturers can use quality data along with ERP order data to power functionality for backward and forward lot track and trace functionality. Existing information can often identify root causes without special case studies or exception-based investigations.

The vertically integrated quality data becomes the basis, and in many cases the impetus, for continuous improvement. This continuous improvement can immediately address the manufacturing operations but can also directly impact product improvements. The association of quality results between the operational production systems such as MES/ERP and design systems such as PLM can drive “designed for quality” initiatives.

RECORDING AND REPORTING

- Resource, order and product data collection
- Structured defect analysis
- Non Conformance tracking
- As-built quality records and reports

- Asset management support
- Genealogy connections and determinations
- Supplier quality and management

Ideally the information technology supporting the vertically integrated quality system will allow for reporting and analysis using standard data management tools. More than one good intentioned quality initiative has been thwarted when the project required manual combinations of data from disjointed sources and silos of spreadsheets. Accessibility and transparency to the data drives the effectiveness of the solution. In modern manufacturing this includes concepts like data marts and access through mobile devices.

CONCLUSIONS

A vertically integrated quality system that allows for systemic coordination between PLM, ERP, MES and production systems best positions a manufacturer to address the full cost of quality and deliver the following benefits:

Overall improvement in product quality and consistently-applied quality processes • Automated analysis to gain insights into trends and risks and to provide the ability to drive continuous improvements

Improved profitability due to a reduction in overall cost of quality throughout all business processes

Improved planning leading to faster NPI, improved quality and reduced costs

Product improvement and extended product viability through closed-loop business planning and execution

For more information on how QAD can help your company address the full cost of quality and deliver the above benefits, contact QAD at: +1-805-566-6100 or email info@qad.com.



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